

5.3.1 Risk Estimation

Risk estimates for aquatic-feeding wildlife receptors exposed to COIs at the Painesville Site are expressed as hazard quotients (HQs), defined as the ratio between the ADD (Section 3.3.3) and the TRV (Section 4.3). HQs are calculated for each COI based on available NOAEL and LOAEL TRVs. If all exposure assumptions are met, a NOAEL HQ less than one indicates negligible risk due to the COI, because a highly protective estimate of exposure does not exceed a highly protective estimate of a “safe” (no-adverse-effect) concentration. A LOAEL HQ greater than or equal to one indicates that adverse ecological effects are possible. When the NOAEL HQ is greater than one but the LOAEL HQ is less than one (or a LOAEL HQ cannot be calculated due to lack of a LOAEL TRV), the estimated risk to wildlife ROIs is indeterminate, because it is unknown at what exposure concentration effects would first become apparent. Thus, the HQs are used to provide an indication that ecological effects are negligible (NOAEL and LOAEL HQs <1), possible (NOAEL and LOAEL HQs >1), or indeterminate (NOAEL HQ >1 and LOAEL HQ <1 or no LOAEL HQ).

It is important to note that HQs exceeding one cannot be used to quantify the magnitude of potential effects, because the HQs are point-estimates based on effect and no-effect exposure concentrations. The magnitude of an adverse effect in a receptor, in addition to being constrained by the assumptions of the exposure characterization, can only be characterized if the dose-response function is known, (*i.e.*, a well-characterized range of exposures associated with a well-defined range of effects).

Nonetheless, point estimates of HQs are useful indicators of ecological risk in a screening-level assessment because this approach provides a means to distinguish between exposure scenarios that do not pose a risk from those that may pose a risk.

Hazard quotients for the Grand River, Lake Erie shoreline, and terrestrial areas are summarized below.

Grand River. Hazard quotients for aquatic-feeding wildlife ROIs exposed to COIs in the Grand River are provided in Table 5-7. Under the assumptions of the exposure and effects characterizations for the Grand River, ecological effects are:

- Unlikely from exposures of all ROIs to bis(2-ethylhexyl)phthalate, all PAHs, benzene, chlorobenzene, ethylbenzene, vinyl chloride, heptachlor epoxide, beryllium, cyanide, hexavalent chromium, lead, mercury, nickel, and selenium;
- Possible from exposures of raccoon to arsenic; and
- Indeterminate for exposures of belted kingfisher and spotted sandpiper to chromium, for exposures of mink to arsenic, for exposures of mink and raccoon to antimony and vanadium, and for exposures of all ROIs to barium.

Lake Erie Shoreline. Hazard quotients for aquatic-feeding wildlife ROIs exposed to COIs at the Lake Erie Shoreline are provided in Table 5-8. Under the assumptions of the exposure and effects characterizations, ecological effects are:

- Unlikely from exposures of all ROIs to bis(2-ethylhexyl)phthalate, carbazole, acenaphthene, acenaphthylene, anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, 2-methylnaphthalene, naphthalene, pyrene, 4,4'-DDE, dieldrin, endosulfan I, methoxychlor, and cyanide; and
- Indeterminate for exposures of belted kingfisher and spotted sandpiper to 4,4'-DDT, and chromium, for exposures of mink and raccoon to benzo(a)anthracene, benzo(b)fluoranthene and chrysene, and for exposures of raccoon to antimony, and for exposures of all ROIs to phenanthrene and total PAHs.

5.3.2 Uncertainty Assessment

The Lake Erie and Grand River Baseline ERA for wildlife is subject to several sources of uncertainty. In general, the Lake Erie and Grand River Baseline ERA approach is intended to provide a risk assessment that is protective of the most sensitive species in the study areas, and several aspects of the exposure and effects assessment are likely to be overly protective, as discussed below. Uncertainty associated with COI selection is discussed in Section 5.1.2.

Exposure Characterization. Assumptions regarding the concentrations of metals in prey and the bioavailability of metals in all ingested media strongly influence the risk estimation for wildlife. Concentrations of metals in invertebrates and fish are estimated from sediment concentrations. Although uptake data are available from the scientific literature for plants and in some cases for soil invertebrates, they are unavailable in some cases for soil invertebrates and in all cases for benthic invertebrates and fish. Where empirical uptake factors are not available, Ohio EPA has required the use of a default uptake factor of 1 (biota concentrations equal

sediment or soil concentrations). For soil invertebrates, uptake factors are generally less than 1 when available from the scientific literature, and it is likely that for many metals, the default uptake assumptions for terrestrial and benthic invertebrates and fish overestimate exposures to wildlife.

As an example, the limited available data for Grand River Study Area fish and bivalves (two individuals) provide total chromium concentrations that are well below the levels estimated using a default BSAF of one. In an estuarine site in New Jersey, total chromium concentrations averaging 700 mg/kg in sediment corresponded to concentrations of only 3 to 5 mg/kg total chromium in crabs and fish (Hall and Pulliam, 1995), for a BSAF of approximately 0.006. Site-specific sediment characteristics such as high organic carbon levels, high specific surface area (small average particle size), nutrient enrichment, reducing conditions, high action concentrations, and high sulfide levels were believed to contribute to the low bioavailability of chromium in sediment at the New Jersey site (Hall and Pulliam, 1995). Thus, while a site-specific BSAF has not been developed for the Grand River, it is likely to be significantly lower than the BSAF of one used in this Lake Erie and Grand River Baseline ERA.

In addition to the uncertainty of estimating total metal concentrations in prey, the bioavailability of metals in prey and environmental media is assumed to be equivalent to the bioavailability of these metals in the toxicity tests used to derive the TRVs. Toxicity studies generally involve administering soluble salts of metals mixed with food, which maximizes bioavailability. The bioavailability of metals may decrease if they are incorporated within prey. For example, the study used in calculating avian TRVs for trivalent chromium used potassium chromic sulfate ($\text{CrK}(\text{SO}_4)_2$) (Sample *et al.*, 1996), which is freely soluble and highly bioavailable. This form of chromium does not occur naturally and was never produced at the Painesville Site. Trivalent chromium in environmental media at the site is expected to be present in much less bioavailable forms such as chromic oxide. The use of a highly bioavailable trivalent chromium salt in toxicity studies may explain why the avian TRVs for trivalent chromium are lower than the TRVs for hexavalent chromium, although the reverse would be expected.

Another protective assumption of the exposure assessment for wildlife is that each ROI forages entirely within a given study area. Actual receptors have no restrictions to their movements and may apportion their use of the area. The foraging area of birds and mammals is a function of habitat suitability and productivity, as well as species-specific foraging behavior, and the spatial

extent of foraging at the Painesville Site is not known for any ROI. In addition, the ROIs are assumed to feed entirely on specified food sources, although some ROIs (e.g., raccoons) may feed opportunistically on a variety of food types.

Other uncertainties in the exposure assessment may result in either overestimation or underestimation of chemical exposures to the ROIs. For example, ROI body weights and ingestion rates are estimated from limited information. The estimation of organic COI concentrations in prey is also uncertain, although it is generally based on applicable scientific literature.

Effects Characterization. The TRVs developed in this Lake Erie and Grand River Baseline ERA are protective point estimates of the sensitivity of avian and mammalian receptors to COIs. The NOAEL and LOAEL TRVs represent the most protective of applicable toxicity test results identified from the literature. Uncertainty factors are used, when needed, to provide TRVs that are representative of chronic exposure and sublethal effects. This approach is likely to overestimate the sensitivity of many ecological receptors. Additionally, the TRVs are most applicable to individual receptors. Depending on the extent and severity of toxicity, effects to individual receptors are not necessarily manifested at the population level.

An aspect of the effects assessment that may contribute to either overestimation or underestimation of risk is the lack of appropriate toxicological information for characterizing effects of several individual chemicals and of mixtures of COIs. Toxicity data are lacking for several COIs, particularly for birds. Additionally, chemicals may act in an additive, antagonistic, or synergistic manner when ingested by wildlife ROIs in a complex mixture. Within chemical classes (e.g., PAHs), effects are believed to be additive, and HQs are summed for PAHs. However, the extent to which different types of chemicals interact to affect toxicity is not known.

5.3.3 Risk Interpretation

The chemicals for which hazard quotient calculations indicate possible or indeterminate ecological effects (Section 5.4.1) are examined using a weight-of-evidence approach to identify chemicals and study areas that merit further attention with regard to Phase II RI activities or redevelopment planning. Sediment and soil concentrations are compared to risk-based concentrations and to background levels as part of the weight of evidence. Risk-based concentrations (RBCs) are site-specific concentrations in soil or sediment that would not result

in risk to a receptor that is exposed solely under the specified assumptions of the exposure characterization (Table 5-6). RBCs are calculated from Equation 3-10 assuming a hazard quotient of 1, and assuming that surface water contributes negligibly to wildlife exposures. Comparison of soil or sediment concentrations from individual locations to an RBC assumes that the wildlife ROI receives its entire exposure from that specific location. The risk interpretation for wildlife is discussed for the Grand River and Lake Erie shoreline areas as follows.

Grand River. Estimated exposures of wildlife receptors to antimony, arsenic, total chromium, and vanadium result in HQs greater than one. However, the wildlife exposure assessment for metals is particularly uncertain and has the potential to be over-protective (Section 5.4.2).

Lake Erie Shoreline. Estimated exposures of wildlife receptors to total PAHs and several individual PAHs, 4,4'-DDT, antimony, and total chromium, result in HQs greater than one; however, none of these COIs is identified as posing an unacceptable risk to wildlife.

6.0 CONCLUSIONS

In this Lake Erie and Grand River Baseline ERA for Site-wide issues, numerous chemicals detected in sediment and surface waters at the Painesville Site are determined to be unlikely to adversely affect ecological receptors. However, a small number of chemicals are identified as posing potentially unacceptable or indeterminate risk to ecological receptors in certain areas of the Site.

The aquatic community degradation resulting in nonattainment observed at RM 3.5 in 2001, 2002 and 2003, and partial attainment at RM 3.9 (GR-5) in 2000 and 2001, can be attributed to a number of possible stressors such as water quality, lacustuary effects, and habitat quality and changes. QHEI values at this location suggest that attainment of WWH should be possible, so habitat quality is unlikely to be the sole cause of nonattainment at this location. The biological sampling results from 2000, 2001, and 2002 taken together suggest that 1) stressors such as water quality, lake levels, or other phenomena make it difficult for a resident, well-balanced fish community capable of meeting ecoregional biological criteria to become established in the upper lacustuary portion of the Grand River near RM 3.5., and; 2) that no single cause is evident for the River's not meeting promulgated biocriteria in some years.

Total Dissolved Solids (TDS) have decreased in mean concentration and in variability from the 1960's to the present. Infrequent exceedences of surface water quality standards have been observed in later years. For example, there have been only two exceedences of the TDS water quality standard out of over 360 samples taken during the Phase I and Phase II sampling events (1997 – 2001). These two exceedences were located at RM 4.7, a location adjacent to the final drainage area of former Settling Basin #4. This overall decreasing trend in TDS is expected to continue, but potential sources of TDS (e.g., Solvay) will continue to exist. Infrequent, localized exceedences of TDS could be having an impact on aquatic life in the Grand River, and may partially explain the non-attainment and partial-attainment of aquatic life use seen in portions of the river.

Measured Cr (VI) concentrations in the Grand River exceed the chronic surface water quality criterion frequently, although the majority (83%) of these exceedances are two times the chronic surface water quality standard or less. Periodic exceedences of the OMZM criterion for Cr (VI) have also been observed both within the study area and downstream of the Painesville WPCF

(11% of samples collected between 1995 and 2002). The majority (70%) of the exceedences of the chronic water quality standard for Cr (VI) observed during the Phase 2 RI occurred adjacent to or immediately downstream of Study Area 6, although numerous exceedences have also been observed downstream of the Painesville WPCF (25% of samples collected between 1995 and 2002). Therefore, Cr (VI) appears to be entering the Grand River from or adjacent to Study Area 6. Study Area 6 is a regulated landfill that contains chromium ore processing residue. Because of the generally reducing conditions present within Area 6, it is likely that the exceedences of Cr (VI) in the Grand River are reduced in both frequency and magnitude as compared to what might be expected through casual estimations based upon concentrations of Cr (VI) in soil and groundwater within the site. However, frequent exceedences of the water quality standards protective of aquatic life for Cr (VI) in the immediate vicinity of Study Area 6 and in downstream segments of the Grand River pose a documented risk to aquatic life.

Potential releases of COIs from groundwater discharges to the Grand River and Lake Erie were evaluated using BIOSCREEN, a U.S. EPA groundwater fate and transport model. The predicted surface water concentrations at the point of discharge were compared to surface water quality standards for the protection of aquatic life and wildlife. All chemicals detected in groundwater at concentrations above their respective Outside Mixing Zone Average (OMZA) water quality standards were evaluated for their potential to migrate and discharge into Lake Erie and/or the Grand River, with assistance from OEPA. The BIOSCREEN model was used to predict concentrations of chemicals of interest in groundwater at the point of discharge to surface water, assuming the maximum detected concentrations in each well migrate to the Lake and/or River by the shortest groundwater flow path. Model predicted concentrations at the points of discharge were compared to OMZA surface water quality standards for the protection of aquatic life and wildlife. Model predicted concentrations at the points of discharge to the Grand River exceed the OMZA surface water quality standards for nine chemicals (antimony, arsenic, barium, chromium VI, copper, cyanide, selenium, mercury and vanadium). Model predicted concentrations at the point of discharge to Lake Erie exceed the OMZA surface water quality standards for eight chemicals (antimony, carbon tetrachloride, chloroform, cobalt, cyanide, methylene chloride, selenium and silver).

PCBs have been detected in fish tissue samples taken in the Grand River both upstream of the Site and on-site by programs outside of the RI for the Site. PCBs detected in three soil samples at the Site were found to have the potential to enter the Grand River. . However, no significant,

substantial sources of PCBs have been identified at the Site and a complete pathway to fish from Painesville site soils (e.g., entrained contaminated soils in runoff or flood waters, to the Grand River, to sediment, to benthic macroinvertebrates, to fish) cannot be established based on available data.

Risks to benthic invertebrates from sediment in the Grand River are indeterminate for most PAHs, but naphthalene was detected at a concentration above the consensus-based sediment quality guidelines (SQGs) Probable Effects Concentrations (PEC) at three locations. These exceedences fit into a category specified by , MacDonald et al. (2000) and Ingersoll et al. (2000) as having probable toxicity to benthic invertebrates. The locations where PAHs were detected in Grand River sediments are adjacent to Study Areas 4, 5 and 6. These Study Areas are not currently or historically the location of activities generating PAHs, and thus are not considered potential sources of these compounds. Based on comparisons to appropriate sediment quality benchmarks, detected levels of ethylbenzene in two river sediment samples fit into a category specified as having unlikely ecological effects.

Based upon the results of this Lake Erie and Grand River Baseline ERA, it is concluded that the following chemicals detected in groundwater at the Site should be evaluated in the Feasibility Study (FS) because their model predicted concentrations exceed OMZA surface water quality standards for the protection of aquatic species and/or wildlife at the point of discharge to either Lake Erie or the Grand River:

- **Grand River**
 - Antimony
 - Arsenic
 - Barium
 - Hexavalent chromium
 - Copper
 - Cyanide
 - Selenium
 - Mercury
 - Vanadium
- **Lake Erie**
 - Antimony
 - Carbon tetrachloride
 - Chloroform
 - Cobalt
 - Cyanide
 - Methylene chloride
 - Selenium
 - Silver

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**DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT**

TABLE 2-1
APPROXIMATE TERRESTRIAL LAND COVER TYPES (PERCENT OF AREA) AT THE PAINESVILLE WORKS SITE

Terrestrial Areas	Size (acres)	Vegetated					Developed		
		Old Field	Mixed Old Field & Shrub-Scrub	Shrub-Scrub	Mixed Shrub-Scrub & Forest	Forested	Bare Ground with Trees	Industrial	Maintained
Study Area 1	164	20%	1%	--	--	--	--	46%	33%
Study Area 2	41	76%	--	--	--	--	--	24%	--
Study Area 3	27.76	93%	--	--	--	--	--	7%	--
Study Area 4	178	27%	27%	12%	8%	2%	3%	8%	9%
Study Area 5	29	79%	--	21%	--	--	--	--	4%
Study Area 6	149	12%	--	13%	--	2%	--	--	--
Study Area 7	520	60%	7%	21%	--	7%	--	--	--
Total Area	1108.76	44%	8%	14%	1%	4%	<1%	10%	18%
									<1%

All values are rounded.

-- Land cover type not present in study area.

DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT

TABLE 2-2
BIOLOGICAL DATA SOURCE BY RIVER MILE FROM 1987 - 2002

River Mile	Data Source & Year Sampled ^a	Site	Metrics Sampled	Sampling Method	Drainage Area (sq. miles)
Fish/Invert.					
0.6/0.8	Ohio EPA, 1987	[BI, Miwb, ICI, QHEI]		Boat	705
0.8/0.7	Ohio EPA, 1993	[BI, Miwb, ICI]		Boat	705
2.0	Ohio EPA, 1988	[CI]		n/a	702
2.0/2.1	Ohio EPA, 1987	[BI, Miwb, ICI, QHEI]		Boat	702
3.0/3.0	Ohio EPA, 1987	[BI, Miwb, ICI, QHEI]		Boat	701
3.2/3.1	Ohio EPA, 1994	[BI, Miwb, ICI, QHEI]		Boat	701
3.5/3.5	Enviroscience, 2000 & 2001	GR-6	[BI, Miwb, ICI, QHEI]	Boat	693
3.5	Hull & Associates, Inc., 2002	GR-6	[BI, Miwb, QHEI]	Boat	693
3.8	Ohio EPA, 1993	[CI]		n/a	692
3.9/3.9	Enviroscience, 2000 & 2001	GR-5	[BI, Miwb, ICI, QHEI]	Boat	692
4.2/4.2	Ohio EPA, 1994	[BI, Miwb, ICI, QHEI]		Boat	698
4.4/4.3	Ohio EPA, 1987	[BI, Miwb, ICI, QHEI]		Boat	698
4.6	Ohio EPA, 1993	[BI, Miwb]		Boat	698
4.6/4.7	Ohio EPA, 1994	[BI, Miwb, ICI, QHEI]		Boat	698
4.7/4.7	Enviroscience, 2000 & 2001	GR-3	[BI, Miwb, ICI, QHEI]	Vading	688
5.2	Ohio EPA, 1987	[BI, Miwb, QHEI]		Vading	688
5.5/5.5	Enviroscience, 2000 & 2001	GR-2	[BI, Miwb, ICI, QHEI]	Vading	678
6.1/6.2	Ohio EPA, 1987	[BI, Miwb, ICI, QHEI]		Vading	687
6.2/6.2	Ohio EPA, 1995	[BI, Miwb, ICI, QHEI]		Vading	687
6.6/6.4	Ohio EPA, 1994	[BI, Miwb, ICI, QHEI]		Vading	687
8.0	Ohio EPA, 1995	[BI, Miwb, QHEI]		Vading	686
8.4	Ohio EPA, 1988	[CI]		n/a	685
8.8	Ohio EPA, 1991	[CI]		n/a	685
9.0	Ohio EPA, 1987	[BI, Miwb, QHEI]		Vading	685
13.4/13.6	Ohio EPA, 1987	[BI, Miwb, ICI, QHEI]		Vading	630
13.4/13.6	Ohio EPA, 1995	[BI, Miwb, ICI, QHEI]		Vading	630

a. Ohio EPA, 1987 data can be found in the Biological and Water Quality Study of the Grand River (OEPA, 1987).

Ohio EPA, 1988 and 1993 data is unpublished and was obtained from the OEPA Environmental Assessment Unit (OEPA, 1988; 1993).

Ohio EPA, 1994 and 1995 data can be found in the Biological and Sediment Quality Study (OEPA, 1995)

Enviroscience 2000 & 2001 data can be found in the Enviroscience Aquatic Survey reports (Enviroscience, 2001; 2002).

**DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT**

TABLE 2-3

SUMMARY OF QHEI DATA COLLECTED ON THE GRAND RIVER BETWEEN 1987-2002

		WWH Attributes										MWH Attributes																				
River Mile	QHEI	No Channelization or Boulder/Cobble/Gravel	Silt Free Substrates	Good/ Excellent Substrates	Moderate/High Sinuosity	Extensive/Moderate Cover	Fast Current/Eddies	Overall	Max Depth >40 cm	Low/Normal	Riffle	Total WWH Attributes	Channelization or No Slit/Muck Substrates	High Influence Low Sinuosity	High Influence Sparse/No Cover	High Influence Max Depth <40cm	Total H.I. MWH	Recovering Channel	Heavy/Mod. Silt Cover	Sand Substrates (Boat)	Hardpan	Substrate	Fair/Poor Development	Low/No Sinuosity	Only 1-2 Cover Types	Intermittent or Poor No Fast Current	No Fast Current	High/Mod.	Overall	High/Mod.	Riffle	Total M.I. MWH
Grand R. 2002																																
3.5	56.5	X X					X X	4		X X	2	X		X X		X X									5							
Grand R. 2001																																
3.5	62	X X	X				X X	5		X X	2	X		X X		X		X		X		X		4								
3.9	79	X X	X X X				X X X	8			0	X		X X		X		X		X		X		3								
4.7	91.75	X X	X X X	X X X			X X X	9			0	X												0								
5.5	88.75	X X	X X X	X X X			X X X	9			0	X												0								
Grand R. 2000																																
3.5	57.5	X X					X X X	5		X X	2	X		X X		X		X		X		X		3								
3.9	64.5	X	X	X	X		X X X	6		X	1	X		X X		X		X		X		X		3								
4.7	84	X X	X	X	X	X X X	X X X	8		X	1	X										X		1								
5.5	81	X X	X X	X X	X X	X X X	X X X	8		X	1	X												0								
Grand R. 1995																																
6.2	76	X X	X X X	X X X	X X X	X X X	X X X	8		X	1	X									X X		3									
8.0	78	X X	X X X	X X X	X X X	X X X	X X X	8		X	1	X											0									
13.4	91	X X	X X X	X X X	X X X	X X X	X X X	8			0	X											0									
Grand R. 1994																																
3.2	53.5	X X					X X	3		X	1	X		X X		X X		X X		X		X		6								
4.2	54.5	X X					X X	3		X	1	X		X X		X X		X X		X		X		6								
4.6	62	X X	X				X X	5		X	1	X		X X		X X		X X		X		X		6								
6.6	77.5	X X	X	X	X	X X X	X X X	7			0	X												2								
Grand R. 1987																																
0.6	51	X X					X		X	4						0	X X	X X	X X	X X	X X	X X	X X	7								
2.0	52.5	X X		X X			X		X	5						0	X	X	X	X	X X	X X	X X	5								
3.0	50.5	X X						X		3	X		1	X	X X	X X	X X	X X	X X	X X	X X	X X	6									
4.4	59	X		X			X		X	3	X		1	X X	X X	X X	X X	X X	X X	X X	X X	X X	6									
5.2	67	X X X						X X X	X X X	6	X		1					X X X	X X X	X X X	X X X	X X X	4									
6.1	82	X X X	X X X	X X X	X X X	X X X	X X X	X X X	X X X	10			0										0									
9.0	81.5	X X X	X X X	X X X	X X X	X X X	X X X	X X X	X X X	10			0										0									
13.4	90	X X X	X X X	X X X	X X X	X X X	X X X	X X X	X X X	10			0										0									

Notes:

1. Scores above 75 should sustain biological communities indicative of EWH.
2. Scores above 60 should sustain biological communities indicative of WWH.
3. Scores above 45 should sustain biological communities indicative of MWH.

**DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT**

TABLE 2-4

**BENTHIC INVERTEBRATE TAXA COLLECTED IN THE GRAND RIVER STUDY AREA
(ENVIROSCIENCE 2000, 2001)**

PHYLUM CLASS Order Family	Common Name	ENVIROSCIENCE 2000 Presence in Location:				ENVIROSCIENCE 2001 Presence in Location:		
		GR2	GR3	GR5	GR6	GR2	GR3	GR5*
ANNELIDA			X	X	X	X	X	
OLIGOCHAETA		X	X	X	X	X	X	
ARTHROPODA		X						X
CRUSTACEA		X						X
<i>Isopoda (Sow bugs)</i>		X						
Asellidae	Sow bugs	X						
<i>Lirceus sp.</i>		X						
Ostracoda								X
INSECTA			X	X	X	X	X	
<i>Coleoptera (Beetles)</i>		X	X	X	X	X	X	
Elmidae	Riffle beetles	X	X	X	X	X	X	
<i>Ancyronyx sp. (damaged)</i>			X					
<i>Ancyronyx sp.</i>								
<i>Ancyronyx variegata</i>								X
<i>Dubiraphia sp.</i>								
<i>Machironychus glabrates</i>		X	X	X	X	X	X	
<i>Stenelmis sp.</i>		X	X			X	X	
<i>Stenelmis sp. larvae</i>						X	X	
<i>Stenelmis crenata</i>						X		
<i>Stenelmis decorata</i>								
<i>Stenelmis douglasensis</i>								
<i>Stenelmis vittipennis</i>								
Gyrinidae	Whirligig beetles	X						
<i>Gyretes sp.</i>		X						
<i>Gyrinus sp.</i>		X						
Haliplidae	Crawling water beetles	X						
<i>Halipus sp.</i>		X						
Hydrophilidae	Water scavenger beetles	X	X		X			
<i>Berosus sp.</i>		X	X		X			
Psephenidae	Water pennies	X		X		X		
<i>Psephenus herricki</i>		X		X		X		
Diptera (Flies)		X	X	X	X	X	X	
Athericidae								
<i>Atherix sp.</i>								
Chironomidae	Midges	X	X	X	X	X	X	
Damaged				X	X			
Pupae				X	X			
Residual			X	X	X			
Chironominae			X	X	X			
Chironomini			X	X	X			
<i>Chironomus</i>			X	X	X			
<i>Chironomus decorus grp.</i>				X				
<i>Cryptochironomus sp.</i>				X				
<i>Dicrotendipes nervosus grp.</i>				X				
<i>Dicrotendipes neomodestus</i>			X	X	X			
<i>Endochironomus sp.</i>				X	X			
<i>Glyptotendipes sp.</i>				X	X			
<i>Microtendipes pedellus grp.</i>		X	X	X	X			
<i>Phaenopsectra</i>			X	X				
<i>Polypedilum convictum</i>			X	X				
<i>Polypedilum fallax grp. b</i>			X	X				
<i>Polypedilum illinoense</i>			X	X				
<i>Polypedilum scalaenum</i>			X		X			

**DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT**

TABLE 2-4 (cont.)

**BENTHIC INVERTEBRATE TAXA COLLECTED IN THE GRAND RIVER STUDY AREA
(ENVIROSCIENCE 2000, 2001)**

PHYLUM	CLASS	Order	Family	Common Name	ENVIROSCIENCE 2000 Presence in Location:				ENVIROSCIENCE 2001 Presence in Location:			
					GR2	GR3	GR5	GR6	GR2	GR3	GR5*	GR6
					X		X	X				
					X		X	X				
			Tanytarsini		X	X	X		X		X	
			<i>Paratanytarsus</i> sp.			X			X		X	
			<i>Rheotanytarsus exiguns</i> grp.		X	X			X		X	
			<i>Tanytarsus glabrescens</i> grp.			X			X		X	
			Empididae	Dance flies								
			Ephydriidae	Shore and brine flies	X	X		X	X		X	
			Orthocladiinae		X							
			<i>Cardiocladus obscurus</i>		X							
			<i>Thienemanniella</i> sp.			X						
			<i>Parakiefferiella</i> sp.				X					
			<i>Corynoneura taris</i>					X				
			<i>Cricotopus</i> sp.			X	X					
			<i>Cricotopus remulus</i> grp.				X	X				
			<i>Cricotopus trifascia</i> grp.				X		X			
			<i>Nanocladus parvulus</i> grp.				X			X		
			Simuliidae			X						
			<i>Simulium</i> sp.				X					
			<i>Hexatoma</i> sp.					X				
			Tanypodinae		X	X	X		X		X	
			<i>Meropelopia</i> sp.		X	X	X		X		X	
			Tipulidae	Crane flies			X	X				
			<i>Antocha</i> sp.				X		X			
			<i>Tipula</i> sp.					X				
			<i>Ephemeroptera</i> (Mayflies)		X	X	X	X	X	X		X
			Residual		X	X						
			Damaged			X						
			Baetidae	Mayflies	X		X	X	X	X		
			<i>Acentrella</i> sp.				X					
			<i>Baetis amplus</i>				X					
			<i>Baetis flavistriga</i>					X				
			<i>Baetis intercalaris</i>						X		X	
			<i>Baetis</i> sp.							X		
			<i>Centroptilum</i> sp.					X				
			<i>Paraclocoda</i> sp.						X			
			Caenidae	Mayflies	X	X	X	X	X	X	X	X
			Damaged				X					
			<i>Caenis</i> sp.		X	X	X	X	X	X	X	X
			Ephemeridae	Burrowing mayflies	X	X						
			<i>Ephemeraria varia</i>			X						
			Ephemerellidae		X	X						
			<i>Ephemerella velmae</i>				X					
			<i>Eurylophella</i> sp.					X				
			<i>Serratella definiens</i>						X			
			Heptageniidae	Stream mayflies	X	X	X					
			<i>Leucrocuta</i> sp.		X	X			X		X	X
			<i>Stenacron</i> sp.		X	X	X		X		X	X
			<i>Stenonema femoratum</i>		X		X		X		X	X
			<i>Stenonema</i> sp.			X			X			
			<i>Stenonema</i> sp. (Damaged)		X	X			X			
			<i>Stenonema pulchellum</i>		X	X						
			<i>Stenonema terminatum</i>		X	X	X		X			
			Damaged				X		X			
			Isonychiidae		X	X	X	X	X	X	X	
			<i>Isonychia</i> sp.			X	X	X	X			
			Leptophlebiidae		X	X	X	X	X			
			<i>Paraleptophlebia</i> sp.	Mayflies	X		X					

**DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT**

TABLE 2-4 (cont.)

**BENTHIC INVERTEBRATE TAXA COLLECTED IN THE GRAND RIVER STUDY AREA
(ENVIROSCIENCE 2000, 2001)**

PHYLUM CLASS Order Family	Common Name	ENVIROSCIENCE 2000 Presence in Location:				ENVIROSCIENCE 2001 Presence in Location:		
		GR2	GR3	GR5	GR6	GR2	GR3	GR5*
Potamanthidae	Mayflies	X	X	X	X	X		X
<i>Anthopotamus cufous</i>		X				X		
<i>Anthopotamus sp.</i>			X	X	X			
<i>Potomanthus</i>			X					X
Tricorythidae	Mayflies	X	X			X	X	X
<i>Tricorythodes sp.</i>		X	X			X	X	X
<i>Plecoptera (Stoneflies)</i>								
Perlidae	Common stoneflies	X	X			X	X	
<i>Agnetina sp.</i>		X	X			X	X	
<i>Agnetina flavescens</i>			X			X	X	
<i>Acroneuria</i>			X					X
<i>Eccoptura sp.</i>			X					
<i>Neoperla sp.</i>			X				X	
Damaged						X		
<i>Odonta (Dragonflies and damselflies)</i>		X		X	X			X
Damaged		X						
Calopterygidae	Broad-winged damselflies	X						
<i>Calopteryx aequable</i>		X						
Coenagrionidae	Narrow-winged damselflies	X				X		X
<i>Argia sp.</i>						X		X
<i>Argia moesta</i>						X		
<i>Argia translata</i>		X						
<i>Enallagma antennatum</i>		X						
<i>Amphiagrion sp.</i>		X						
Gomphidae	Clubtails			X	X			X
<i>Dromogomphus sp.</i>				X	X			X
<i>Gomphus sp.</i>				X	X			
<i>Hemiptera (True bugs)</i>								
Corixidae		X				X		
<i>Trichocorixa sp.</i>						X		
Nepidae	Water scorpions	X				X		
<i>Ranatra sp.</i>		X				X		
Veliidae		X				X		
<i>Microvelia sp.</i>		X				X		
<i>Neuroptera (Lacewings and allies)</i>								
Corydalidae	Dobsonflies					X	X	X
<i>Corydalus conutus</i>						X	X	X
Sialidae	Alderflies					X	X	X
<i>Hydropsyche sp.</i>						X	X	X
<i>Sialis sp.</i>						X		X
<i>Trichoptera (Caddisflies)</i>								
Immature		X	X	X		X	X	X
Residual		X						
Helicopsychidae	Snail-case caddisflies	X						
<i>Helicopsyche borealis</i>						X		
Hydropsychidae	Net-spinning caddisflies	X	X	X		X		X
Residual		X				X		
<i>Cheumatopsyche sp.</i>		X	X	X		X		X
<i>Macrosternum sp.</i>		X	X			X		X
<i>Ceratopsyche morosa group</i>		X	X			X		X
<i>Ceratopsyche spama</i>		X				X		X
<i>Hydropsyche dicantha</i>		X				X		
<i>Hydropsyche frisoni</i>			X			X		
<i>Hydropsyche scalaris</i>			X			X		
<i>Hydropsyche depravata grp.</i>			X			X		
<i>Hydropsyche sp.</i>			X			X		

**DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT**

TABLE 2-4 (cont.)

**BENTHIC INVERTEBRATE TAXA COLLECTED IN THE GRAND RIVER STUDY AREA
(ENVIROSCIENCE 2000, 2001)**

PHYLUM CLASS Order Family	Common Name	ENVIROSCIENCE 2000 Presence in Location:				ENVIROSCIENCE 2001 Presence in Location:		
		GR2	GR3	GR5	GR6	GR2	GR3	GR5 ^a
Hydroptilidae	Microcaddisflies					X	X	
<i>Hydroptila</i> sp. (damaged)						X		
<i>Hydroptila</i> sp.						X	X	
Leptoceridae	Long-horned caddisflies							
<i>Ceraclea</i> sp.								
Philopotamidae	Finger-net caddisflies	X	X	X		X	X	
<i>Chimarra</i> sp.		X	X	X		X	X	
Polycentropodidae	Trumpet-net and tube-making caddisflies	X	X	X	X	X	X	
<i>Cernotina</i> sp.		X						
<i>Cymellus</i> sp.				X	X	X		
<i>Neurealypsis</i> sp.								X
<i>Polycentropus</i> sp.								
Psychomyiidae	Tube-making caddisflies	X	X	X				
<i>Lype</i> sp.		X	X					
<i>Psychomyia</i> sp.								
<i>Lepidoptera (Moths and butterflies)</i>		X				X	X	
Pupa		X						
Pyralidae	Pyralid moths	X				X	X	
<i>Petrophila</i> sp.		X						
MOLLUSCA								
BIVALVIA								
Dreissenidae		X	X			X	X	
<i>Dreissena polymorpha</i>		X	X			X	X	
Sphaeriidae	Clam					X	X	
<i>Sphaerium</i>						X	X	
Corbiculidae		X	X					
<i>Corbicula fluminea</i>		X	X					
GASTROPODA								
Damaged		X	X	X	X	X	X	
Ancylidae	Snail					X	X	
<i>Ferrissia rivatriss</i>						X	X	
<i>Ferrissia</i> sp.						X	X	
Hydrobiidae	Snail	X		X				
<i>Amnicola limosa</i>		X		X				
<i>Gilia altilis</i>		X		X				
Limnaeidae		X	X			X		
<i>Fossaria humilis</i>		X						
<i>Fossaria parva</i>		X						
<i>Stagnicola catastropium</i>						X		
<i>Stagnicola elodes</i>						X		
Physidae	Snail		X		X	X	X	
<i>Physella</i> sp.			X		X	X	X	
Pleuroceridae	Snail	X	X	X		X	X	
<i>Climia</i> sp.		X	X	X		X	X	
<i>Goniobasis livescens</i>								
<i>Pleurocera</i> sp.								
Valvatidae						X		
<i>Valvata</i> sp.						X		
PLATYHELMINTHES								
Turbellaria	Flatworm	X	X	X	X	X	X	
Planariidae		X	X	X	X	X	X	

a. A complete set of benchmark sheets for GR5, 2001, was not included in the Enviroscience Report.

b. *Fallax* was also spelled as *fallas* in benchmark sheets.

**DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT**

TABLE 2-5

SUMMARY OF MACROINVERTEBRATE DATA COLLECTED IN THE GRAND RIVER FROM 1987-2001

River Mile	Relative Density	Quant. Taxa	Qual Taxa	Qual EPT	Total Taxa	ICI	Narrative Evaluation
Grand River 2001							
Erie-Ontario Lake Plain Ecoregion - Interim Lacustuary Biocriteria							
3.5	*	*	*	4	12	16	Fair
3.9	*	*	*	3	28	28	Good
Erie-Ontario Lake Plain Ecoregion - WWH Use Designation (Existing)							
4.7	*	*	*	10	35	44	Very Good
5.5	*	*	*	14	35	42	Very Good
Grand River 2000							
Erie-Ontario Lake Plain Ecoregion - Interim Lacustuary Biocriteria							
3.5	*	*	*	2	16	18	Poor
3.9	*	*	*	9	27	38	Good
Erie-Ontario Lake Plain Ecoregion - WWH Use Designation (Existing)							
4.7	*	*	*	15	28	46	Very Good
5.5	*	*	*	15	35	40	Very Good
Grand River 1995							
Erie-Ontario Lake Plain Ecoregion - EWH Use Designation (Existing)							
6.2	3785	38	55	20	71	44	Very Good
13.6	1115	48	55	16	81	52	Exceptional
Grand River 1994							
Erie-Ontario Lake Plain Ecoregion - Interim Lacustuary Biocriteria							
3.1	879	14	19	2	28	16	Fair
4.2	309	44	29	6	56	26	Good
4.7	131	47	47	18	81	30	Very Good
Erie-Ontario Lake Plain Ecoregion - EWH Use Designation (Existing)							
6.4	42	27	43	17	58	32	Very Good
Grand River 1993							
Erie-Ontario Lake Plain Ecoregion - Interim Lacustuary Biocriteria							
0.7	*	*	*	*	*	16	Fair
2.1	*	*	*	*	*	8	Poor
3.8	*	*	*	*	*	44	Good/Very Good
Grand River 1991							
Erie-Ontario Lake Plain Ecoregion - EWH Use Designation (Existing)							
8.8	*	*	*	21	56	48	Exceptional
Grand River 1987							
Erie-Ontario Lake Plain Ecoregion - Interim Lacustuary Biocriteria							
0.8	*	*	*	*	*	32	Marg. Good/Good
2.1	*	*	*	*	*	16	Fair
3.0	1104	33	29	6	50	30	Marg. Good
4.3	441	42	45	11	66	56	Exceptional
Erie-Ontario Lake Plain Ecoregion - EWH Use Designation (Existing)							
6.2	1117	44	64	27	77	46	Very Good/Except.
13.6	*	*	*	*	*	50	Exceptional

Notes:

- This data was not made available for the table.

**DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT**

TABLE 2-6

**FISH SPECIES COLLECTED IN THE GRAND RIVER STUDY AREA
(OEPA 1995, 1997; ENVIROSCIENCE 2000, 2001, HULL 2002)**

<i>Order</i> <i>Family</i>	Scientific Name	Common Name
<i>Lepisosteiformes</i> Lepisosteidae	<i>Lepisosteus osseus</i>	Longnose gar
<i>Clupeiformes</i> Clupeidae	<i>Dorosoma cepedianum</i>	Gizzard shad
<i>Salmoniformes</i> Salmonidae	<i>Oncorhynchus kisutch</i> <i>Oncorhynchus mykiss</i>	Coho salmon Rainbow trout
Osmeridae	<i>Osmerus mordax</i>	Rainbow smelt
<i>Cypriniformes</i> Catostomidae	<i>Carpioles cyprinus</i> <i>Catostomus commersoni</i> <i>Hypentelium nigricans</i> <i>Ictiobus bubalus</i> <i>Minytrema melanops</i> <i>Moxostoma anisurum</i> <i>Moxostoma carinatum</i> <i>Moxostoma duquesnei</i> <i>Moxostoma erythrurum</i> <i>Moxostoma macrolepidotum</i>	Quillback carpsucker White sucker Northern hog sucker Smallmouth buffalo Spotted sucker Silver redhorse River redhorse Black redhorse Golden redhorse Shorthead redhorse
Cyprinidae	<i>Campostoma anomalum</i> <i>Campostoma anomalum pullum</i> <i>Cyprinus carpio</i> <i>Hybopsis amblops</i> <i>Nocomis micropogon</i> <i>Notemigonus crysoleucas</i> <i>Notropis atherinoides</i> <i>Notropis chryscephalus</i> <i>Notropis cornutus</i> <i>Notropis photogenis</i> <i>Notropis rubellus</i> <i>Notropis spilopterus</i> <i>Notropis stramineus</i> <i>Notropis volucellus</i> <i>Pimephales notatus</i> Hybrid	Ohio stoneroller minnow Central stoneroller Common carp Bigeye chub River chub Golden shiner Emerald shiner Striped shiner Common shiner Silver shiner Rosyface shiner Spotfin shiner Sand shiner Mimic shiner Bluntnose minnow Common carp X goldfish

**DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT**

**TABLE 2-6
(CONTINUED)**

**FISH SPECIES COLLECTED IN THE GRAND RIVER STUDY AREA
(OEPA 1995, 1997; ENVIROSCIENCE 2000, 2001, HULL 2002)**

Order Family	Scientific Name	Common Name
<i>Siluriformes</i> Ictaluridae	<i>Ictalurus natalis</i> <i>Ictalurus nebulosus</i> <i>Ictalurus punctatus</i> <i>Noturus flavus</i> <i>Noturus miurus</i>	Yellow bullhead Brown bullhead Channel catfish Stonecat madtom Brindled madtom
<i>Percopsiformes</i> Percopsidae	<i>Percopsis omiscomaycus</i>	Trout-perch
<i>Atheriniformes</i> Atherinidae	<i>Labidesthes sicculus</i>	Brook silverside
<i>Perciformes</i> Serranidae	<i>Morone americana</i> <i>Morone chrysops</i>	White perch White bass
Centrachidae	<i>Ambloplites rupestris</i> <i>Lepomis cyanellus</i> <i>Lepomis gibbosus</i> <i>Lepomis humilis</i> <i>Lepomis macrochirus</i> <i>Lepomis megalotis peltastes</i> <i>Micropterus dolomieu</i> <i>Micropterus salmoides</i> <i>Pomoxis annularis</i> <i>Pomoxis nigromaculatus</i> Hybrid	Rockbass Green sunfish Pumpkinseed sunfish Orangespotted sunfish Bluegill sunfish Longear sunfish Smallmouth bass Largemouth bass White crappie Black crappie Green sunfish x pumkinseed
Percidae	<i>Etheostoma blennioides</i> <i>Etheostoma caeruleum</i> <i>Etheostoma flabellare</i> <i>Etheostoma nigrum</i> <i>Perca flavescens</i> <i>Percina caprodes</i> <i>Percina caprodes semifasciata</i> <i>Percina maculata</i> <i>Stizostedion vitreum vitreum</i>	Greenside darter Rainbow darter Fantail darter Johnny darter Yellow perch Logperch Northern logperch darter Blackside darter Walleye
Sciaenidae	<i>Aplodinotus grunniens</i>	Freshwater drum
<i>Gobiesociformes</i> Gobiidae	<i>Neogobius melanostomus</i>	Round goby

**DIAMOND SHAMROCK PAINESVILLE WORK SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT**

TABLE 2-7

SUMMARY OF FISH DATA COLLECTED ON THE GRAND RIVER BETWEEN 1987-2002

River Mile	Mean No. Species	Cumulative Species	Mean Rel. No.	Mean Rel. Wt.	QHEI	Mean MlwB	Mean IBI	Narrative Evaluation
Grand River 2002								
Erie-Ontario Lake Plain Ecoregion - Benchmark Lacustuar Biocriteria								
3.5	13	13	252	121.7	56.5	8.3	26	Marg. Good/Poor
Grand River 2001								
Erie-Ontario Lake Plain Ecoregion - Benchmark Lacustuar Biocriteria								
3.5	*	*	174	16.4	62	6.29	32	Fair/Fair
3.9	*	*	219	37.3	79	7.2	35.5	Fair/Fair
Erie-Ontario Lake Plain Ecoregion - WWH Use Designation (Existing)								
4.7	*	*	276	14.7	91.75	8.5	42	Marg. Good/Good
5.5	*	*	438.8	36	88.75	8.7	40	Good/Good
Grand River 2000								
Erie-Ontario Lake Plain Ecoregion - Benchmark Lacustuar Biocriteria								
3.5	*	*	125	21.8	57.5	6.8	26.5	Fair/Poor
3.9	*	*	169	31.4	64.5	7.5	27.5	Fair/Poor
Erie-Ontario Lake Plain Ecoregion - WWH Use Designation (Existing)								
4.7	*	*	960	73	84	7.9	40	Good/Good
5.5	*	*	1127.5	151.5	81	8.6	46	Good/Very Good
Grand River 1995								
Erie-Ontario Lake Plain Ecoregion - EWH Use Designation (Existing)								
6.2	24.5	32	478	40.3	76	9.4	47	Very Good
8.0	22.5	32	362	74.6	78	9.2	52	Very Good/Except.
13.4	22.5	26	550	44.1	91	9.1	52	Very Good/Except.
Grand River 1994								
Erie-Ontario Lake Plain Ecoregion - Interim Lacustuar Biocriteria								
3.2	13	16	87	11.6	53.5	7.1	28	Fair
4.2	15	21	115	19.3	54.5	7.3	41	Fair/Good
4.6	17.5	23	248	35.7	62	8.5	49	Mod. Good/Except.
Erie-Ontario Lake Plain Ecoregion - EWH Use Designation (Existing)								
6.6	24	*	350	51.3	77.5	9.7	54	Exceptional
Grand River 1993								
Erie-Ontario Lake Plain Ecoregion - Interim Lacustuar Biocriteria								
0.8	*	*	*	*	**	3.5	28	Very Poor/Fair
2	*	*	*	*	**	6.7	36	Fair/Marg. Good
4.6	*	*	*	*	**	7.8	30	Fair
Grand River 1988								
Erie-Ontario Lake Plain Ecoregion - Interim Lacustuar Biocriteria								
2.0	*	*	*	*	**	7.2	44	Fair/Good

Notes:

* = This data was not made available for the table.

** = No data collected.

**DIAMOND SHAMROCK PAINESVILLE WORK SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT**

**TABLE 2-7
(CONTINUED)**

SUMMARY OF FISH DATA COLLECTED ON THE GRAND RIVER BETWEEN 1987-2002

River Mile	Mean No. Species	Cumulative Species	Mean Rel. No.	Mean Rel. Wt.	QHEI	Mean MlwB	Mean IBI	Narrative Evaluation
Grand River 1987								
Erie-Ontario Lake Plain Ecoregion - Interim Lacustuar Biocriteria								
0.6	*	*	*	*	51	8.3	37	Marginally Good
2.0	*	*	*	*	52.5	8.3	44	Marg. Good/V. Good
3.0	*	*	*	*	50.5	5.8	33	Poor/Fair
4.4	*	*	*	*	59	6.6	30	Fair
Erie-Ontario Lake Plain Ecoregion - WWH Use Designation (Existing)								
5.2	*	*	*	*	67	9.1	48	Very Good
Erie-Ontario Lake Plain Ecoregion - EWH Use Designation (Existing)								
6.1	24.5	20	326	64.6	77	9.4	54	Very Good/Except.
9.0	23.5	23	137.4	15.2	80	9.2	52	Good/Very Good
13.4	23.5	24	562	32.9	91	9.5	48	Very Good/Except.

Notes:

* = This data was not made available for the table.

** = No data collected.

**DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT**

TABLE 2-8

**AQUATIC LIFE USE ATTAINMENT STATUS FOR THE GRAND RIVER BASED UPON
SAMPLING CONDUCTED BETWEEN 1987-2002**

River Mile Fish/Invert.	IBI	MIwb	ICI	QHEI	Attainment Status	Comments
Grand River 2002						
Erie-Ontario Lake Plain Ecoregion - Benchmark Lacustuar Biocriteria						
3.5°	26"	8.3 ^{ns}	*	56.5	Non-Attainment	IBI fails (poor)
Grand River 2001						
Erie-Ontario Lake Plain Ecoregion - Benchmark Lacustuar Biocriteria						
3.5 ^B /3.5	32"	6.29#	16"	62	Non-Attainment	both indices fail
3.9 ^B /3.9	35.5"	7.2"	42	79	Partial	IBI & MIwb fair
Erie-Ontario Lake Plain Ecoregion - WWH Use Designation						
4.7 ^w /4.7	42	8.5	44	91.75	Full	
5.5 ^w /5.5	40	8.7	42	88.75	Full	
Grand River 2000						
Erie-Ontario Lake Plain Ecoregion - Benchmark Lacustuar Biocriteria						
3.5 ^B /3.5	26.5#	6.8#	18#	57.5	Non-Attainment	IBI & MIwb fail (IBI poor)
3.9 ^B /3.9	27.5#	7.5#	38	64.5	Non-Attainment	IBI & MIwb fail (IBI poor)
Erie-Ontario Lake Plain Ecoregion - WWH Use Designation						
4.7 ^w /4.7	40	7.9	46	84	Full	
5.5 ^w /5.5	46	8.6	40	81	Full	
Grand River 1995						
Erie-Ontario Lake Plain Ecoregion - EWH Use Designation						
6.2 ^w /6.2	47 ^{ns}	9.4	44 ^{ns}	76	Full	
8.0 ^w	52	9.2 ^{ns}	*	78	Full	
13.4 ^w /13.6	52	9.1 ^{ns}	52	91	Full	
Grand River 1994						
Erie-Ontario Lake Plain Ecoregion - Interim Lacustuar Biocriteria						
3.2 ^B /3.1	28 ^{ns}	7.1 ^{ns}	16#	53.5	Partial	ICI fails (Fair)
4.2 ^B /4.2	41	7.3 ^{ns}	26	54.5	Full	
4.6 ^B /4.7	49	8.5	30	62	Full	
Erie-Ontario Lake Plain Ecoregion - EWH Use Designation						
6.6 ^w /6.4	54	9.7	32"	77.5	Partial	ICI fails

Notes:

* = No data collected.

w = Wading Site.

B = Boat Site.

ns = Nonsignificant departure from biocriteria (≤ 4 IBI or ICI units, or ≤ 0.5 MIwb units.)

= Significant departure from biocriteria (> 4 IBI or ICI units, or > 0.5 MIwb units). Underlined scores are in the Poor or Very Poor range.

Attainment status is based on biocriteria for the Erie-Ontario Lake Plain ecoregion of Ohio (OAC 3745-1-07, Table 7-17) and interim Lake Erie lacustuar biocriteria under development by the Ohio EPA.

**DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT**

**TABLE 2-8
(CONTINUED)**

**AQUATIC LIFE USE ATTAINMENT STATUS FOR THE GRAND RIVER BASED UPON
SAMPLING CONDUCTED BETWEEN 1987-2001.**

River Mile Fish/Invert.	IBI	MIwb	ICI	QHEI	Attainment Status	Comments
Grand River 1993						
Erie-Ontario Lake Plain Ecoregion - Interim Lacustuary Biocriteria						
0.8 ^B /0.7	28 ^{ns}	<u>3.5</u> [#]	<u>16</u> [#]	*	Partial	MIwb and ICI fail
2.0 ^B /2.1	36	<u>6.7</u> [#]	<u>8</u> [#]	*	Partial	MIwb and ICI fail
3.8	*	*	44	*	Full	
4.6 ^B	30	7.8	*	*	Full	
Grand River 1991						
Erie-Ontario Lake Plain Ecoregion - EWH Use Designation						
8.8	*	*	48	*	Full	
Grand River 1988						
Erie-Ontario Lake Plain Ecoregion - Interim Lacustuary Biocriteria						
2.0 ^B	44	7.2 ^{ns}	*	*	Full	
Erie-Ontario Lake Plain Ecoregion - EWH Use Designation						
8.4	*	*	34 [#]	*	Partial	ICI fails
Grand River 1987						
Erie-Ontario Lake Plain Ecoregion - Interim Lacustuary Biocriteria						
0.6 ^B /0.8	37	8.3	32	51	Full	
2.0 ^B /2.1	44	8.3	<u>16</u> [#]	52.5	Partial	ICI fails
3.0 ^B /3.0	33	<u>5.8</u> [#]	30	50.5	Partial	MIwb fails
4.4 ^B /4.3	30 ^{ns}	6.6 [#]	56	59	Partial	MIwb fails
Erie-Ontario Lake Plain Ecoregion - WWH Use Designation						
5.2 ^w	48	9.1	*	67	Full	
Erie-Ontario Lake Plain Ecoregion - EWH Use Designation						
6.1 ^w /6.2	54	9.4	46	82	Full	
9.0 ^w	52	9.2 ^{ns}	*	81.5	Full	
13.4 ^w /13.6	48 ^{ns}	9.5	50	90	Full	

Notes:

* = No data collected.

w = Wading Site.

B = Boat Site.

ns = Nonsignificant departure from biocriteria (<4 IBI or ICI units, or <0.5 MIwb units.)

= Significant departure from biocriteria (>4 IBI or ICI units, or >0.5 MIwb units). Underlined scores are in the Poor or Very Poor range.

Attainment status is based on biocriteria for the Erie-Ontario Lake Plain ecoregion of Ohio (OAC 3745-1-07, Table 7-17) and interim Lake Erie lacustuary biocriteria under development by the Ohio EPA.

**DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT**

TABLE 2-9

PLANT SPECIES OBSERVED DURING THE OCTOBER 1997 RECONNAISSANCE OF THE PAINESVILLE WORKS SITE

Vegetation Type	Scientific Name	Common Name	Scientific Name	Common Name	Scientific Name	Common Name	Common Name
Trees	<i>Acer negundo</i>	bogelder	<i>Fraxinus pennsylvanica</i>	green ash	<i>Quercus rubra</i>	red oak	
	<i>Acer rubrum</i>	red maple	<i>Malus coronaria</i>	sweet crab apple	<i>Rhamnus</i> spp.	buckthorn	
	<i>Acer saccharinum</i>	silver maple	<i>Morus alba</i>	white mulberry	<i>Rhus typhina</i>	staghorn sumac	
	<i>Allianthus altissima</i>	tree-of-heaven	<i>Populus deltoides</i>	eastern cottonwood	<i>Robinia pseudoacacia</i>	black locust	
	<i>Crataegus</i> spp.	hawthorn	<i>Quercus alba</i>	white oak	<i>Salix</i> spp.	various willows	
	<i>Fraxinus americana</i>	white ash	<i>Quercus velutina</i>	black oak	<i>Ulmus fulva</i>	slippery elm	
Shrubs & Vines	<i>Cornus stolonifera</i>	red osier dogwood	<i>Rubus allegheniensis</i>	blackberry	<i>Viburnum dentatum</i>	arrowwood	
	<i>Lonicera tatarica</i>	Tatarian honeysuckle	<i>Rubus</i> spp.	raspberry	<i>Viburnum trilobum</i>	highbush cranberry	
	<i>Rosa multiflora</i>	multiflora rose	<i>Toxicodendron radicans</i>	poison ivy	<i>Vitis</i> spp.	grape	
Grasses & Forbs	<i>Achillea millefolium</i>	yarrow	<i>Dipsacus sylvestris</i>	teasel	<i>Polygonum cuspidatum</i>	Japanese knotweed	
	<i>Alliaria officinalis</i>	garlic mustard	<i>Echium vulgare</i>	viper's bugloss	<i>Rumex crispus</i>	dock	
	<i>Apocynum androsaemifolium</i>	dogbane	<i>Equisetum hyemale</i>	horsetail	<i>Setaria</i> spp.	foxtails	
	<i>Arctium minus</i>	burdock	<i>Eupatorium perfoliatum</i>	boneset	<i>Solidago</i> spp.	various goldenrods	
	<i>Aster novae-angliae</i>	New England aster	<i>Linaria vulgaris</i>	butter & eggs	<i>Trifolium pratense</i>	red clover	
	<i>Aster</i> spp.	various asters	<i>Lythrum salicaria</i>	purple loosestrife	<i>Trifolium repens</i>	white clover	
	<i>Cichorium intybus</i>	chicory	<i>Phalaris arundinacea</i>	reed canary grass	<i>Typha</i> spp.	cattail	
	<i>Cirsium vulgare</i>	bull thistle	<i>Phragmites australis</i>	common reed	<i>Verbascum thapsus</i>	common mullein	
	<i>Coronilla varia</i>	crown vetch	<i>Plantago major</i>	common plantain	<i>Xanthium strumarium</i>	cocklebur	
	<i>Daucus carota</i>	wild carrot	<i>Poa pratensis</i>	kentucky bluegrass			

**DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT**

TABLE 2-10

**SOIL QUALITY CHARACTERISTICS IN TERRESTRIAL STUDY AREAS
OF THE PAINESVILLE WORK SITE^a**

Parameter (units)	Detection Frequency	Minimum	Maximum	Arithmetic Mean	Arithmetic Standard Deviation
Study Area 1					
Moisture (%)	2/2	13.1	18.6	15.9	3.89
pH (standard units)	3/3	7.62	8.37	7.96	0.38
Total Organic Carbon (%)	2/2	0.78	2.09	1.44	0.93
Study Area 2					
Moisture (%)	3/3	13.5	22.8	17.7	4.7
pH (standard units)	3/3	3.84	7.02	5.79	1.71
Total Organic Carbon (%)	3/3	0.33	1.76	0.99	0.72
Study Area 3					
Moisture (%)	4/4	10.5	17.5	14.3	3.3
pH (standard units)	4/4	7.24	8.46	7.56	0.60
Total Organic Carbon (%)	4/4	0.36	0.78	0.54	0.17
Study Area 4					
Moisture (%)	6/6	8.48	44.6	22.4	14.7
pH (standard units)	30/30	5.8	8.25	7.43	0.52
Total Organic Carbon (%)	5/5	0.17	1.52	0.60	0.54
Study Area 5					
Moisture (%)	4/4	8.30	12.8	11.6	2.2
pH (standard units)	24/24	3.6	8.64	7.41	0.87
Total Organic Carbon (%)	4/4	0.2	0.56	0.32	0.16
Study Area 7					
Moisture (%)	30/30	8.01	69.2	41.9	16.5
pH (standard units)	30/30	6.69	12.3	8.56	1.53
Total Organic Carbon (%)	5/5	0.203	1.1	0.51	0.35

a Includes areas of ecologically relevant land cover, i.e., all vegetative land cover types depicted in Figure 2-2, except "Industrial Habitat" and "Recreational Areas".

Areas identified as "Maintained Areas" will also be evaluated in the Operable Unit Risk Assessments.

DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT

TABLE 2-11

POTENTIAL FOR PCBs DETECTED IN SURFACE SOILS WITHIN 1000' OF THE GRAND RIVER
TO SERVE AS A SOURCE TO THE RIVER

Sampling Location	Sampling Location Description	Soil Content (ppm)	Distance from River (ft.)	Vegetation Type	Proximity to Grand River	Proximity to River, flooding potential	Basis/Reasons
SW5-1	2000	1800	1260	100	Yes	Shrub/Scrub	Yes
SW4-5	1997	59	1260	250	Yes	Shrub/Scrub	No
SW4-1	1997	74	1260	667	No	Grass	No
SB7-17	2000	100	1248	230	Yes	Shrub/Scrub	Yes
	2000	52	1254	230	Yes	Shrub/Scrub	Yes
	2000	84	1260	230	Yes	Shrub/Scrub	Yes
SB7-18	2000	1,100	1254	500	Yes	Shrub/Scrub/Grass	Yes
SB7-19	2000	310	1248	730	Yes	Shrub/Scrub	No
	2000	180	1254	730	Yes	Shrub/Scrub	No
SB7-20	2000	47	1248	850	No	Grass	No
						Low	Low
						Low	Distance from River

DIAMOND SHAMROCK PAINSVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT

TABLE 2-12

Sitewide PCB Detections in Surface Soils (0 to 4 feet) in 2000

Parcel ID	Owner	Sample ID	Sample Date	Analyte	Result	Units
1A2	RDL Properties	SB1-28,0-4'	15-Sep-00	Aroclor-1248	90	UG/KG
1A2	RDL Properties	SB1-28,0-4'	15-Sep-00	Aroclor-1254	120	UG/KG
1A2	RDL Properties	SB1-28,0-4'	15-Sep-00	Aroclor-1260	150	UG/KG
1A3	Shuster Service Inc.	SB1-32,0-4'	11-Sep-00	Aroclor-1260	19	UG/KG
1A4	Tartan Marine	SB1-31,0-4'	11-Sep-00	Aroclor-1260	850	UG/KG
1A5	Ralph M. Lederer	SB1-27,0-4'	11-Sep-00	Aroclor-1254	2300	UG/KG
1A6	James Paul Management, Inc.	SB1-35,0-4'	11-Sep-00	Aroclor-1260	240	UG/KG
1A7	Inc. and Paul and Marlena Hach	SB1-33,0-4'	12-Sep-00	Aroclor-1254	41	UG/KG
1A7	Inc. and Paul and Marlena Hach	SB1-33,0-4'	12-Sep-00	Aroclor-1260	45	UG/KG
1A7	Inc. and Paul and Marlena Hach	SB1-37,0-4'	13-Sep-00	Aroclor-1254	22	UG/KG
1A7	Inc. and Paul and Marlena Hach	SB1-37,0-4'	13-Sep-00	Aroclor-1260	46	UG/KG
1A7	Inc. and Paul and Marlena Hach	SB1-38,0-4'	13-Sep-00	Aroclor-1254	150	UG/KG
1A7	Inc. and Paul and Marlena Hach	SB1-38,0-4'	13-Sep-00	Aroclor-1260	170	UG/KG
1A7	Inc. and Paul and Marlena Hach	SB1-39,0-4'	13-Sep-00	Aroclor-1254	110	UG/KG
1A7	Inc. and Paul and Marlena Hach	SB1-39,0-4'	13-Sep-00	Aroclor-1260	470	UG/KG
1A8	Shuster Service Inc.	SB1-30,0-4'	11-Sep-00	Aroclor-1260	8.5	UG/KG
1A9	James Paul Management, Inc.	SB1-36,0-4'	11-Sep-00	Aroclor-1260	50	UG/KG
1B1	Tierra Solutions Incorporated	SB1-45,0-4'	09-Nov-00	Aroclor-1260	30000	UG/KG
1B1	Tierra Solutions Incorporated	SB1-46,0-4'	10-Nov-00	Aroclor-1254	56	UG/KG
1B1	Tierra Solutions Incorporated	SB1-46,0-4'	10-Nov-00	Aroclor-1260	200	UG/KG
1B1	Tierra Solutions Incorporated	SB1-47,0-4'	10-Nov-00	Aroclor-1254	260	UG/KG
1B1	Tierra Solutions Incorporated	SB1-47,0-4'	10-Nov-00	Aroclor-1260	290	UG/KG
1B1	Tierra Solutions Incorporated	SB1-48,0-4'	13-Nov-00	Aroclor-1260	500	UG/KG
1B1	Tierra Solutions Incorporated	SB1-49,0-4'	10-Nov-00	Aroclor-1254	38	UG/KG
1B1	Tierra Solutions Incorporated	SB1-50,0-4'	09-Nov-00	Aroclor-1260	2400	UG/KG
1B1	Tierra Solutions Incorporated	SB1-51,0-4'	09-Nov-00	Aroclor-1254	440	UG/KG
1B1	Tierra Solutions Incorporated	SB1-51,0-4'	09-Nov-00	Aroclor-1260	360	UG/KG
1B1	Tierra Solutions Incorporated	SB1-52,0-4'	09-Nov-00	Aroclor-1260	340	UG/KG
1B1	Tierra Solutions Incorporated	SP1-2,0-4'	20-Sep-00	Aroclor-1260	290	UG/KG
1B1	Tierra Solutions Incorporated	SW1-15,0-4'	05-Oct-00	Aroclor-1248	64	UG/KG
1B1	Tierra Solutions Incorporated	SW1-15,0-4'	05-Oct-00	Aroclor-1254	98	UG/KG
1B1	Tierra Solutions Incorporated	SW1-15,0-4'	05-Oct-00	Aroclor-1260	230	UG/KG
1B1	Tierra Solutions Incorporated	SW1-16,0-4'	05-Oct-00	Aroclor-1248	23	UG/KG
1B1	Tierra Solutions Incorporated	SW1-16,0-4'	05-Oct-00	Aroclor-1254	24	UG/KG
1B1	Tierra Solutions Incorporated	SW1-16,0-4'	05-Oct-00	Aroclor-1260	90	UG/KG
1B1	Tierra Solutions Incorporated	SW1-9,0-4'	13-Nov-00	Aroclor-1260	29	UG/KG
1C1	Norfolk Southern Corp.	SB1-20,0-4'	21-Sep-00	Aroclor-1254	38	UG/KG
1C1	Norfolk Southern Corp.	SB1-20,0-4'	21-Sep-00	Aroclor-1260	8.4	UG/KG
1C1	Norfolk Southern Corp.	SB1-22,0-4'	21-Sep-00	Aroclor-1254	260	UG/KG
1C1	Norfolk Southern Corp.	SB1-22,0-4'	21-Sep-00	Aroclor-1260	280	UG/KG
1C1	Norfolk Southern Corp.	SB1-23,0-4'	20-Sep-00	Aroclor-1260	29	UG/KG

DIAMOND SHAMROCK PAINSVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT

Table 2-12 CONTINUED

Sitewide PCB Detections in Surface Soils (0 to 4 feet) in 2000

Parcel ID	Owner	Sample ID	Sample Date	Analyte	Result	Units
1C1	Norfolk Southern Corp.	SB1-24,0-4'	20-Sep-00	Aroclor-1260	380	UG/KG
1C1	Norfolk Southern Corp.	SB1-25,0-4'	20-Sep-00	Aroclor-1248	61	UG/KG
1C1	Norfolk Southern Corp.	SB1-25,0-4'	20-Sep-00	Aroclor-1254	53	UG/KG
1C1	Norfolk Southern Corp.	SB1-25,0-4'	20-Sep-00	Aroclor-1260	130	UG/KG
1C1	Norfolk Southern Corp.	SB1-40,0-4'	20-Sep-00	Aroclor-1260	86	UG/KG
1C2	Tanner Industries	SB1-29,0-2'	11-Sep-00	Aroclor-1260	13000	UG/KG
1C5	Dartron Corporation	SB1-16,0-4'	22-Sep-00	Aroclor-1254	720	UG/KG
1C5	Dartron Corporation	SB1-16,0-4'	22-Sep-00	Aroclor-1260	170	UG/KG
1C5	Dartron Corporation	SB1-18,0-4'	22-Sep-00	Aroclor-1254	62	UG/KG
1C5	Dartron Corporation	SB1-18,0-4'	22-Sep-00	Aroclor-1260	39	UG/KG
1C5	Dartron Corporation	SB1-19,0-4'	22-Sep-00	Aroclor-1254	110	UG/KG
1C5	Dartron Corporation	SB1-19,0-4'	22-Sep-00	Aroclor-1260	77	UG/KG
4A1	Little Seedlings (Hach)	SS4-1,0-4'	13-Sep-00	Aroclor-1254	110	UG/KG
4A1	Little Seedlings (Hach)	SS4-1,0-4'	13-Sep-00	Aroclor-1260	300	UG/KG
4B3	Village of Fairport Harbor	SB4-22,0-4'	15-Sep-00	Aroclor-1254	73	UG/KG
4B3	Village of Fairport Harbor	SB4-22,0-4'	15-Sep-00	Aroclor-1260	140	UG/KG
4B3	Village of Fairport Harbor	SW4-11,0-4'	28-Sep-00	Aroclor-1254	8.3	UG/KG
5B1	Tierra Solutions Incorporated	SW5-1,0-4'	26-Sep-00	Aroclor-1260	1800	UG/KG
7B1	Painesville Twp	SB7-17,0-4'	18-Sep-00	Aroclor-1248	100	UG/KG
7B1	Painesville Twp	SB7-17,0-4'	18-Sep-00	Aroclor-1254	52	UG/KG
7B1	Painesville Twp	SB7-17,0-4'	18-Sep-00	Aroclor-1260	84	UG/KG
7B1	Painesville Twp	SB7-18,0-4'	18-Sep-00	Aroclor-1254	1100	UG/KG
7B1	Painesville Twp	SB7-19,0-4'	15-Sep-00	Aroclor-1248	310	UG/KG
7B1	Painesville Twp	SB7-19,0-4'	15-Sep-00	Aroclor-1254	180	UG/KG
7B1	Painesville Twp	SB7-20,0-4'	15-Sep-00	Aroclor-1248	47	UG/KG
7B1	Painesville Twp	SB7-20,0-4'	15-Sep-00	Aroclor-1254	21	UG/KG
7C2	Nacelle	SB7-25,0-4'	18-Sep-00	Aroclor-1248	15	UG/KG
7C2	Nacelle	SB7-25,0-4'	18-Sep-00	Aroclor-1260	6.5	UG/KG
7C2	Nacelle	SB7-26,0-4'	18-Sep-00	Aroclor-1260	5	UG/KG
7C3	Nicholson	SB7-14,0-4'	25-Sep-00	Aroclor-1248	6.9	UG/KG
7C3	Nicholson	SB7-7,0-4'	25-Sep-00	Aroclor-1248	15	UG/KG
7C3	Nicholson	SB7-7,0-4',MS	25-Sep-00	Aroclor-1248	11	UG/KG
7C3	Nicholson	SB7-7,0-4',MSD	25-Sep-00	Aroclor-1248	9.4	UG/KG
7C3	Nicholson	SW7-10,0-4'	25-Sep-00	Aroclor-1248	13	UG/KG
7C3	Nicholson	SW7-10,0-4'	25-Sep-00	Aroclor-1254	6.4	UG/KG
7C4	Westholm	SB7-16,0-4'	15-Sep-00	Aroclor-1254	82	UG/KG

**DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT**

TABLE 2-13

**SEDIMENT AND SURFACE WATER QUALITY CHARACTERISTICS IN THE GRAND RIVER
AND LAKE ERIE STUDY AREAS OF THE PAINESVILLE WORK SITE^a**

Parameter (units)	Detection Frequency	Minimum	Maximum	Arithmetic Mean	Arithmetic Standard Deviation
Grand River Surface Water					
Alkalinity to pH 4.5	100/100	42.3	118	94.6	8.89
Alkalinity to pH 8.3	5/100	0.940	13.4	0.437	1.48
Sulfate	200/200	32.4	181	52.1	14.1
Total Alkalinity	100/200	80.5	124	55.0	55.2
Total Dissolved Solids ^b	358/358	0.00	2,940	796	398
Total Organic Carbon (%)	200/200	5.40	26.6	6.976	1.69
Biochemical Oxygen Demand (mg/L)	2/2	1.45	1.65	1.55	0.14
Chemical Oxygen Demand (mg/L)	2/2	33	35	34	1
Chloride (mg/L)	202/202	49.00	1,230	168	127
Conductivity (umhos/cm)	2/2	1,727	1,817	1,772	64
Dissolved Oxygen (mg/L)	2/2	8.00	8.10	8.05	0.07
Fecal Coliform (#/100 mL)	2/2	263	300	282	26
Hardness (mg/L)	102/118	156	1,020	275	112
Kjeldahl Nitrogen ^b (mg/L)	6/6	0.02	0.80	0.37	0.36
Nitrite & Nitrate Nitrogen ^b (mg/L)	2/18	0.23	0.37	0.30	0.10
Nitrite Nitrogen ^b , mg/L	2/18	0.02	0.02	0.02	NC
pH (standard units)	172/183	6.8	8.5	7.8	0.3
Phosphate (mg/L)	2/2	0.05	0.05	0.05	NC
Residue, Total Nonfilterable (mg/L)	2/2	11	11	11	NC
Temperature (°C)	2/2	24	24	24	NC
Grand River Sediment					
Total Organic Carbon (%)	7/7	0.53	2.53	1.32	0.68
Lake Erie Sediment					
Moisture (%)	8/8	17.7	25.65	22.0	3.0
pH (standard units)	4/4	7.84	8.67	8.3	0.4
Total Organic Carbon (%)	4/4	0.4	0.5	0.4	0.05

a. Sample locations and dates sampled for parameters presented in this table are shown in Appendix D.

b. Maximum value for TDS presented is the maximum detected through Phase II RI sampling, as determined through review of the draft RI Report (SECOR, 2002). Detection summaries and minimum/maximum detect were not summarized because data were unavailable for this draft report.

**DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT**

TABLE 2-14

**TOTAL DISSOLVED SOLIDS (TDS) CONCENTRATIONS MEASURED
IN THE GRAND RIVER**

River Mile	Number of Samples	Mean (mg/L)	Minimum (mg/L)	Maximum (mg/L)	% of Samples > 1500 mg/L
97.6	2	264	258	270	0%
95.4	7	292	258	334	0%
87.62	2	262	260	264	0%
83.5	4	289	278	295	0%
65.9	5	302	296	314	0%
42.4	5	239	186	274	0%
36.3	5	226	196	252	0%
34	5	191	15	250	0%
28.4	5	215	201	230	0%
22.46	5	187	174	198	0%
22.1	5	204	154	236	0%
17.77	1	168	168	168	0%
13.7	1	192	192	192	0%
13.6	5	223	206	254	0%
9.35	1	246	246	246	0%
8.6	7	256	230	297	0%
8.45	45	333	104	470	0%
6.1	13	250	194	306	0%
5.6	21	420	266	470	0%
5.46	4	204	182	236	0%
4.82	1	338	338	338	0%
4.7	20	657	0	1990	5%
4.3	1	758	758	758	0%
4.2	28	612	470	900	0%
3.9	28	616	450	850	0%
3.6	1	1680	1680	1680	100%
3.5	28	869	650	1180	0%
3.1	6	1516	582	2730	50%
3.08	28	898	730	1230	0%
2.76	4	1460	568	2940	50%
2.37	28	908	790	1110	0%
2.3	24	1346	118	3140	46%
1.75	4	985	532	1690	25%
1.1	4	590	220	1080	0%
0.3	4	265	194	374	0%

DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT

TABLE 2-15

SELECTION OF COIS IN SURFACE WATER FOR THE GRAND RIVER AT THE PAINESVILLE SITE

PCOI	Number of Detects	Total Number of Samples	Maximum Concentration (mg/L)	Surface Water Background Concentrations (Mean + 2SD) (mg/L)	Maximum Concentration Exceed Background Concentration?	Region 5 Surface Water EDOL?	Lake Erie Drainage Basin Surface Water Aquatic Life Criteria OMZA ^b (mg/L)	Maximum Concentration Exceed OMZA?	Selected as COI? ^c
									Inorganics
CALCIUM	132	132	472	55.7	YES	NA	NA	NA	NO(1)
CHROMIUM, TOTAL ^d	242	305	0.22	NA	NA	0.042	YES	0.15	YES
HEXAVALENT CHROMIUM, UNFILTERED	178	295	0.039	NA	NA	NA	NA	0.011	YES
HEXAVALENT CHROMIUM, FILTERED	236	300	0.228	NA	NA	NA	NA	0.011	YES
MAGNESIUM	132	132	18.2	15.30	YES	NA	NA	0.011	YES
SODIUM	132	132	278	79,000	YES	NA	NA	NA	NO(1)
TOTAL DISSOLVED SOLIDS	358	358	2,940	NA	NA	NA	NA	1500	YES
									YES

NOTE: although other chemicals were detected in Grand River surface water, the list of analyties was focused during the Phase II sampling to the chemicals in this Table.

a. USEPA EDOL - Ecological Data Quality Levels (USEPA, 1999).

b. USEPA OMZA - "Outside the mixing zone average" aquatic life criteria for the Lake Erie drainage basin OAC 3745-1-33 (USEPA, 2002).

c. Rationale:

No (1) = Analyte is a naturally occurring essential element.

Yes = Analyte meets selection criteria.

d. OMZA for this parameter is water hardness dependent.

NA = Not Available.

COI = Chemical of Interest

LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT
DIAMOND SHAMROCK PAINESVILLE WORKS SITE

TABLE 2-16
SAMPLE LOCATION SOURCES - WATER, SEDIMENT, AND BIOLOGICAL SAMPLING

Data Source	Date	Surface Water Location	Sediment Location	Biological Location	Sample Location Reference
Hull & Associates	2002			GR6	RI Phase II Report Figure 6-1 (SECOR, 2002)
Phase II Remedial Investigation for the Diamond Shamrock Painesville Works Site EnviroScience	2001	GR1 through GR8			RI Phase II Report Figure 6-1 (SECOR, 2002)
EnviroScience	2000			GR2, 3, 5, and 6	RI Phase II Report Figure 6-1 (SECOR, 2002)
Phase II Remedial Investigation for the Diamond Shamrock Painesville Works Site	2000	GR1 through GR8		GR2, 3, 5, and 6	RI Phase II Report Figure 6-1 (SECOR, 2002)
Phase 1 Remedial Investigation for the Diamond Shamrock Painesville Works Site Analytical Data Collected from Sampling of Monitoring Wells in the Painesville Works Site and the Grand River under a USEPA Administrative Order of Consent	1997		SD1-1 SD1-2	SD2-1 SD2-2	RI Phase II Report Figure 1-2 (SECOR, 1999)
Biological and Sediment Quality Study of the Grand River in the Vicinity of the Diamond Shamrock Waste Lagoons Area USEPA Expanded Site Investigation	1994		O-GR-2.97 O-GR-3.48 O-GR-3.8 O-GR-4.04	O-GR-4.06 O-GR-4.45 O-GR-4.82 RM 3.1 RM 4.2	Ohio EPA sampling of the Grand River at Rivermile locations indicated by SampleID (Ohio EPA, 1985)
Biological and Water Quality Study of the Grand River-Lake, Ashtabula, and Geauga Counties A Second Study of Hexavalent Chromium in the Grand River, Ohio	1987	O-GR-2.8	O-GR-3.1	S23 S25 S10 S11 S26 S27 S12 S28 S22	U.S. EPA sampling of the Grand River between Rivermile locations 2.8 - 5.4.
	1988	W-14.4 W-2-1-N-4 W-2-1-S-4 W-2-2-N-3.48 W-2-2-S-3.48 W-2-3-N-3.3	W-2-3-S-3.3 W-2-4-N-3.2 W-2-4-S-3.2 W-3N-3.1 W-3S-3.1	RM 3.0 RM 4.3	Ohio EPA sampling of the Grand River at Rivermile locations indicated by SampleID (Ohio EPA, 1987)
					Dr. Andrew White sampling of the Grand River at Rivermile locations indicated by SampleID (White, 1989)

* Phase II samples locations: GR1 = RM 8.45; GR2 = RM 5.6; GR3 = RM 4.7; GR4 = RM 4.2; GR5 = RM 3.9; GR6 = RM 3.5; GR7 = RM 3.08; GR8 = RM 2.37

**DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT**

TABLE 2-17

BACKGROUND CONCENTRATIONS OF INORGANIC CHEMICALS

Chemical	Surface Water Background Concentrations (mg/L)			Sediment Background Concentrations (mg/kg)		
	Mean	Max. detected	Mean + 2SD	Mean	Max. Detected	Mean + 2SD
Aluminum	1.27	4.88	3.8900	16847.5	52200.0	49429.1
Arsenic (Total)	0.0021	0.0030	0.0027	8.34	15.40	14.9
Barium	0.035	0.053	0.0490	50.4	74.7	85.2
Beryllium	NA	NA	NA	0.4	0.6	0.7
Cadmium	0.0002	0.0004	0.0004	0.8	3.0	2.9
Calcium	34.70	60.0000	55.70	5354.8	10831.5	12008.1
Chromium (Total)	No detects	No detects	No detects	11.5	15.5	18.5
Cobalt	NA	NA	NA	6.7	10.3	13.3
Copper	0.004	0.01	0.011	21.1	42.2	43.9
Iron	1.3335	8.76	4.6648	28658.7	59420.4	59818.4
Lead	0.0051	0.019	0.0141	16.8	31.0	33.1
Magnesium	9.60	16.0000	15.30	4402.3	8266.0	9058.0
Manganese	0.0650	0.2550	0.170	672.0	1111.4	1406.5
Mercury	NA	NA	NA	0.0545*	0.0545	NC
Nickel	No detects	No detects	No detects	16.8	25.2	31.2
Potassium	3.90	9.0000	6.50	1019.0	1850.0	2172.7
Sodium	32.00	157	79.00	NA	NA	NA
Thallium	NA	NA	NA	16.8*	16.8	NC
Vanadium	NA	NA	NA	11.9	15.7	20.5
Zinc	0.0213	0.0830	0.0502	104.2	200.2	213.8

* n=1

NC = Not calculated

NA = Not assessed

Note: The background data is based on data sets provided by Ohio EPA and reflect conditions upstream of the Site, from R.M. 5.5 to R.M. 8.5.

DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT

Table 2-18
Summary Statistics for Sediment Data from East Basin of Lake Erie
(from Painter et al., 2001). All units are mg/kg.

As	Cd	Cr	Hg	Zn	Fe	Cu	Pb	Ni	AI
5.7	0.9	21.7	0.062	121.2	21000	16.2	23.6	20.7	7000
0.7	1	35.9	0.126	168.9	33000	40.4	33.9	43.1	16000
12	1.2	26	0.072	109.5	22000	24.7	25.3	31.5	12000
2.4	0.7	43.1	0.136	198.4	33700	37.7	49.2	54.7	21000
14.4	0.8	37.3	0.097	165.5	34000	38.2	36.5	45.2	18000
12	1.1	32	0.072	130.9	32000	32.6	25.5	39	18000
15.6	1	34	0.086	137.3	33000	33.3	25.8	40.5	19000
15.2		22.4	0.016	76.1	27000	26.2	7.7	29.4	15000
3.9		25.9	0.084	112.2	25000	32.6	32.1	35.5	13000
1.7		16.4	0.016	47.3	20000	14.5	4.4	19.7	9000
8.6		13.6	0.052	74.6	18000	16.9	11.5	21.5	7000
		29.6	0.13	155.7	28000	35.6	32.8	35.5	12000
		24.7	0.045	90.3	26000	24.9	12	28.5	15000
		14	0.016	48.9	18000	17	5	17.6	9000
		9.8	0.014	38.1	13000	5.8	10.3	15.5	4000

Mean	8.38	0.96	25.76	0.07	111.66	25580.00	26.44	22.37	31.86	13000.00
Range	0.7 - 15.6	0.7 - 1.2	9.8 - 43.1	0.014 - 0.136	38.1 - 198.4	13000-34000	5.8- 40.4	4.4 - 49.2	15.5 - 54.7	4000-21000
Mean+2SD	19.83	1.30	45.15	0.15	209.27	39045.77	47.32	49.09	54.83	23056.98

**DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT**

TABLE 2-19

SELECTION OF COIs IN SEDIMENT FOR THE GRAND RIVER AT THE PAINESVILLE WORK SITE

PCOI	Detection Frequency	Maximum Detected Concentration (mg/kg)	Upperbound Site-Specific Background Concentration (mg/kg) ^a	EDQL (mg/kg) ^b	Selected as a COI? ^c
Semivolatile Organic Chemicals (SVOCs)					
Bis(2-ethylhexyl)phthalate	3/18	0.7	--	0.18	Yes
Butyl Benzyl Phthalate	1/18	0.41	--	4.19	No (1)
Polycyclic Aromatic Hydrocarbons (PAHs)					
Benzo(a)anthracene	1/18	0.36	--	0.03	Yes
Chrysene	1/18	0.38	--	0.06	Yes
Fluoranthene	3/17	0.65	--	0.11	Yes
2-Methylnaphthalene	2/18	0.35	--	0.02	Yes
Naphthalene	4/18	4.6	--	0.03	Yes
Phenanthrene	3/18	0.54	--	0.04	Yes
Pyrene	2/17	0.63	--	0.05	Yes
Volatile Organic Compounds (VOCs)					
Benzene	2/11	0.19	--	0.14	Yes
Carbon Disulfide	2/11	0.002	--	0.13	No (1)
Carbon Tetrachloride	2/11	0.003	--	0.04	No (1)
Chlorobenzene	1/11	0.092	--	0.06	Yes
1,1-Dichloroethane	1/22	0.001	--	0.0006	No (2)
1,2-Dichloroethane	2/11	0.01	--	0.05	No (1)
1,2-Dichloroethene	3/11	0.033	--	0.21 ^d	No (1)
Ethylbenzene	2/11	0.53	--	0.0001	Yes
Styrene	1/11	0.009	--	0.44	No (1)
Tetrachloroethene	1/11	0.004	--	0.20	No (1)
Toluene	3/11	0.025	--	52.5	No (1)
Trichloroethene	1/11	0.002	--	0.18	No (1)
Vinyl Chloride	1/11	0.043	--	0.002	Yes
Xylene (Total)	2/11	0.69	--	1.88	No (1)
Pesticides					
4,4'-DDD	1/18	0.0036	--	0.006	No (1)
Heptachlor Epoxide	1/18	0.0021	--	0.0006	Yes
Inorganics					
Aluminum	18/18	17600	49429.1	--	No (4)
Antimony	1/8	4	--	--	Yes
Arsenic	12/18	52.3	14.9	5.90	Yes
Barium	18/18	440	85.2	--	Yes
Beryllium	18/18	3	0.700	--	Yes
Cadmium	8/8	1.89	2.9	0.60	No (4)
Calcium	18/18	158000	12008.1	--	No (3)
Chromium, Total	17/18	111	18.5	26.0	Yes
Chromium, Hexavalent	4/7	5.04	--	--	Yes
Cobalt	18/18	14.6	13.3	50.0	No (1)
Copper	18/18	33	43.9	16.0	No (4)
Cyanide	5/5	2.7	--	0.0001	Yes
Iron	18/18	49400	59818.4	--	No (4)
Lead	17/17	35.5	33.1	31.0	Yes

**DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT**

**TABLE 2-19
(CONTINUED)**

SELECTION OF COIs IN SEDIMENT FOR THE GRAND RIVER AT THE PAINESVILLE WORK SITE

PCOI	Detection Frequency	Maximum Detected Concentration (mg/kg)	Upperbound Site-Specific Background Concentration (mg/kg) ^a	EDQL (mg/kg) ^b	Selected as a COI? ^c
<i>Inorganics (continued)</i>					
Magnesium	17/17	7890	9058.0	--	No (4)
Manganese	18/18	760	1406.5	--	No (4)
Mercury	2/9	0.71	0.0545*	0.17	Yes
Nickel	17/17	37.8	31.2	16.0	Yes
Potassium	18/18	4040	2172.7	--	No (3)
Selenium	1/8	1.1	--	--	Yes
Sodium	17/18	9900	--	--	No (3)
Thallium	1/8	1.9	16.8*	--	No (4)
Vanadium	18/18	43.9	20.5	--	Yes
Zinc	18/18	105	213.8	120	No (1, 4)

a. From Table 2-17; the upperbound concentration is the background mean plus two standard deviations.

b. Region 5 Ecological Data Quality Level (USEPA, 1997b).

c. Rationale:

No (1) = Analyte maximum detected concentration is less than the EDQL value;

No (2) = Analyte is detected infrequently (<5%);

No (3) = Analyte is an essential nutrient

No (4) = Analyte maximum detected concentration is less than upperbound concentration from background locations;

Yes = Analyte meets selection criteria.

d. EDQL for trans-1,2-dichloroethene (USEPA, 1997b).

-- = Not Available

* = Based on one detection reported

PCOI = Potential Chemical of Interest

COI = Chemical of Interest

**DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT**

TABLE 2-20

SELECTION OF COIs IN SEDIMENT FOR LAKE ERIE AT THE PAINESVILLE WORK SITE

PCOI	Detection Frequency	Maximum Detected Concentration (mg/kg)	Upperbound Site-Specific Background Concentration (mg/kg) ^a	EDQL (mg/kg) ^b	Selected as a COI? ^c
Semivolatile Organic Compounds (SVOCs)					
2,4-Dimethylphenol	1/4	0.049	--	0.305	No (1)
Bis(2-ethylhexyl)phthalate	3/4	0.240	--	0.182	Yes
Carbazole	3/4	0.220	--	--	Yes
Dibenzofuran	3/4	0.480	--	1.52	No (1)
Polycyclic Aromatic Hydrocarbons (PAHs)					
Acenaphthene	3/4	0.180	--	0.007	Yes
Acenaphthylene	3/4	0.430	--	0.006	Yes
Anthracene	4/4	1.10	--	0.047	Yes
Benzo(a)anthracene	4/4	2.10	--	0.032	Yes
Benzo(a)pyrene	3/4	1.60	--	0.032	Yes
Benzo(b)fluoranthene	4/4	2.10	--	10.4	Yes ^d
Benzo(g,h,i)perylene	3/4	0.780	--	0.170	Yes
Benzo(k)fluoranthene	3/4	0.680	--	0.240	Yes
Chrysene	4/4	2.00	--	0.057	Yes
Dibenz(a,h)anthracene	3/4	0.370	--	0.006	Yes
Fluoranthene	4/4	4.60	--	0.111	Yes
Fluorene	4/4	0.920	--	0.021	Yes
Indeno(1,2,3-cd)pyrene	3/4	0.890	--	0.200	Yes
2-Methylnaphthalene	3/4	0.280	--	0.020	Yes
Naphthalene	4/4	5.15	--	0.035	Yes
Phenanthrene	4/4	3.00	--	0.042	Yes
Pyrene	4/4	2.90	--	0.053	Yes
Total PAHs	4/4	24.3	--	--	Yes
Volatile Organic Compounds (VOCs)					
Acetone	2/4	0.013	--	0.453	No (1)
Benzene	1/4	0.005	--	0.142	No (1)
Methylene Chloride	4/4	0.006	--	1.26	No (1)
Toluene	1/4	0.002	--	52.5	No (1)
Xylene (Total)	1/4	0.003	--	1.88	No (1)
Pesticides					
4,4'-DDD	2/4	0.003	--	0.006	No (1)
4,4'-DDE	3/4	0.002	--	0.001	Yes
4,4'-DDT	4/4	0.006	--	0.001	Yes
Aldrin	1/4	0.000	--	0.002	No (1)
Alpha-Chlordane	2/4	0.000	--	0.005 ^g	No (1)
Dieldrin	3/4	0.002	--	0.002	Yes
Endosulfan I	1/4	0.000	--	0.0002	Yes
Endosulfan Sulfate	3/4	0.001	--	0.035	No (1)
Endrin	1/4	0.001	--	0.003	No (1)
Endrin Aldehyde	2/4	0.001	--	3.20	No (1)
Endrin Ketone	2/4	0.002	--	0.003 ^h	No (1)
Gamma-Chlordane	3/4	0.001	--	0.005 ^g	No (1)
Heptachlor	1/4	0.000	--	0.0006	No (1)
Heptachlor Epoxide	2/4	0.000	--	0.0006	No (1)
Methoxychlor	4/4	0.028	--	0.004	Yes

**DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT**

**TABLE 2-20
(CONTINUED)**

SELECTION OF COIs IN SEDIMENT FOR LAKE ERIE AT THE PAINESVILLE WORK SITE

PCOI	Detection Frequency	Maximum Detected Concentration (mg/kg)	Upperbound Site-Specific Background Concentration (mg/kg) ^a	EDQL (mg/kg) ^b	Selected as a COI? ^c
Inorganics					
Aluminum	4/4	6665	49429.1	--	No (2)
Antimony	4/4	2.30	--	--	Yes
Arsenic	4/4	12.8	14.9	5.90	No (2)
Barium	4/4	40.4	85.2	--	No (2)
Beryllium	4/4	0.370	0.7	--	No (2)
Cadmium	1/4	0.193	2.9	0.596	No (1, 2)
Calcium	4/4	69200	12008.1	--	No (3)
Chromium, Total	4/4	39.6	18.5	26.0	Yes
Cobalt	4/4	8.80	13.3	50.0	No (1, 2)
Copper	4/4	27.0	43.9	16.0	No (2)
Cyanide	2/4	1.57	--	0.0001	Yes
Iron	4/4	23750	59818.4	--	No (2)
Lead	4/4	22.7	33.1	31.0	No (1, 2)
Magnesium	4/4	11200	9058.0	--	No (3)
Manganese	4/4	402	1406.5	--	No (2)
Mercury	4/4	0.100	0.0545*	0.174	No (1)
Nickel	4/4	22.1	31.2	16.0	No (2)
Potassium	4/4	1190	2172.7	--	No (2)
Silver	1/4	0.110	--	0.500	No (1)
Sodium	1/4	1230	--	--	No (3)
Thallium	2/4	1.60	16.8*	--	No (2)
Vanadium	4/4	9.80	20.5	--	No (2)
Zinc	4/4	116	213.8	120	No (1, 2)

Note: Hexavalent chromium was not detected in Lake Erie sediment above the method detection limit of 0.24 to 0.26 mg/Kg.

a. From Table 2-17; the upperbound concentration is the background mean plus two standard deviations.

b. Region 5 Ecological Data Quality Level (USEPA, 1997b).

c. Rationale:

No (1) = Analyte maximum detected concentration is less than the EDQL value;

No (2) = Analyte maximum detected concentration is less than upperbound concentration from background locations;

No (3) = Analyte is an essential nutrient

Yes = Analyte meets selection criteria.

d. Included as PCOI to evaluate all PAHs as a group.

e. EDQL for chlordane (USEPA, 1997b).

f. EDQL for endrin (USEPA, 1997b).

-- = Not Available

PCOI = Potential Chemical of Interest

COI = Chemical of Interest

* Based on one detection reported

DIAMOND SHAMROCK PAINESVILLE WORKS SITE SITEWIDE BASELINE ECOLOGICAL RISK ASSESSMENT

TABLE 2-21
SUMMARY OF CHEMICALS OF INTEREST (COIs) IN ENVIRONMENTAL MEDIA

**DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT**

TABLE 3-1

SUMMARY STATISTICS FOR COIs IN SEDIMENT FOR THE GRAND RIVER

Chemical	Characterization of Chemical Concentrations						Exposure-Point Concentration (EPC)		Site Concentrations	
	Detection		Range of Detected Concentrations (mg/kg dry weight)			Arithmetic	(mg/kg dry weight) ^c		(mg/kg dry weight at 1% TOC) ^d	
	Frequency	Distribution ^a	Minimum	Maximum	SD ^b	Mean	95% UCL of Mean	Mean	Maximum	
Semivolatile Organic Compounds (SVOCs)										
Bis(2-ethylhexyl)phthalate	3/18	Not Determined	0.3	0.7	0.139	0.255	0.304	0.193	0.529	
Polycyclic Aromatic Hydrocarbons (PAHs)										
Benzo(a)anthracene	1/18	Not Determined	0.36	0.36	0.052	0.217	0.239	0.164	0.272	
Chrysene	1/18	Not Determined	0.38	0.38	0.055	0.218	0.241	0.165	0.287	
Fluoranthene	3/17	Not Determined	0.38	0.65	0.123	0.251	0.298	0.190	0.492	
2-Methylnaphthalene	2/18	Not Determined	0.24	0.35	0.051	0.211	0.233	0.160	0.265	
Naphthalene	4/18	Not Determined	0.33	4.60	1.125	0.629	0.964	0.476	3.479	
Phenanthrene	3/18	Not Determined	0.18	0.54	0.104	0.233	0.271	0.176	0.408	
Pyrene	2/17	Not Determined	0.38	0.63	0.115	0.237	0.277	0.179	0.476	
Volatile Organic Compounds (VOCs)										
Benzene	2/11	Not Determined	0.075	0.190	0.058	0.027	0.116	0.020	0.144	
Chlorobenzene	1/11	Not Determined	0.092	0.092	0.027	0.012	0.020	0.009	0.070	
Ethylbenzene	2/11	Not Determined	0.003	0.530	0.159	0.051	0.125	0.039	0.401	
Vinyl Chloride	1/11	Not Determined	0.043	0.043	0.011	0.011	0.015	0.008	0.033	
Pesticides										
Heptachlor Epoxide	1/18	Not Determined	0.0021	0.0021	NA	0.0021	0.0021	0.002	0.002	
Inorganics										
Antimony	1/8	Not Determined	4	4	NA	4	4	--	--	
Arsenic	12/18	Undefined	7.7	52.3	10.8	11.8	15.7	--	--	
Barium	19/19	Undefined	10.4	440	99.8	59.3	88.6	44.87	332.74	
Beryllium	18/18	Undefined	0.28	3	0.636	0.612	0.797	--	--	
Chromium, Hexavalent	4/7	Not Determined	1.83	5.04	1.99	1.9	5.0	--	--	
Chromium, Total	17/18	Lognormal	4.9	111	30.0	25.8	51.3	--	--	
Cyanide	5/5	Not Determined	0.76	2.7	0.9	1.6	2.7	--	--	
Lead	17/17	Lognormal	5.5	35.5	6.8	12.3	15.1	--	--	
Mercury	2/9	Not Determined	0.26	0.71	0.12	0.42	0.50	--	--	
Nickel	17/17	Lognormal	6.5	37.8	7.7	14.3	18.1	--	--	
Selenium	1/8	Not Determined	1.1	1.1	NA	1.1	1.1	--	--	
Vanadium	18/18	Lognormal	4.6	43.9	10.5	13.1	18.5	--	--	

a Distributions are characterized, based on dry-weight concentrations, using methods described by D'Agostino et al. (1990):

Distributions are "Not Determined" if N<8 or detection frequency<50%;

Distributions are "Undefined" if conditions for normality or log-normality were not met;

Distributions which are "Not Determined" or "Undefined" are assumed to be lognormal for calculation of upperbound EPCs.

b SD = Standard deviation

c The mean EPC is the arithmetic mean, using one half the detection limit for non-detects.

The upperbound EPC is the 95UCL (for either normally distributed or log-transformed data), using one half the detection limit for non-detects.

d Analyte concentrations adjusted to 1% TOC based on an average TOC concentration of 1.32% TOC (dry weight), derived from Grand River sediment samples.

NA Not applicable; value exceeds the maximum detected concentration.

**DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT**

TABLE 3-2

SUMMARY STATISTICS FOR COIs IN LAKE ERIE SEDIMENT

Chemical	Characterization of Chemical Concentrations								
	Detection		Range of Detected Concentrations (mg/kg dry weight)			Exposure-Point Concentration (EPC) (mg/kg dry weight) ^c		Site Concentrations (mg/kg dry weight at 1% TOC) ^d	
	Frequency	Distribution ^a	Minimum	Maximum	SD ^b	Mean	Detected Maximum	Mean	Maximum
Semivolatile Organic Compounds (SVOCs)									
Bis(2-ethylhexyl)phthalate	3/4	Not Determined	0.1125	0.24	0.079	0.148	0.240	0.332	0.537
Carbazole	3/4	Not Determined	0.11	0.22	0.082	0.116	0.220	0.261	0.493
Polycyclic Aromatic Hydrocarbons (PAHs)									
Acenaphthene	3/4	Not Determined	0.064	0.18	0.070	0.099	0.180	0.221	0.403
Acenaphthylene	3/4	Not Determined	0.095	0.43	0.178	0.181	0.430	0.406	0.963
Anthracene	4/4	Not Determined	0.078	1.1	0.446	0.492	1.10	1.10	2.46
Benzo(a)anthracene	4/4	Not Determined	0.056	2.1	0.867	0.904	2.10	2.02	4.70
Benzo(a)pyrene	3/4	Not Determined	0.395	1.6	0.674	0.674	1.60	1.51	3.58
Benzo(b)fluoranthene	4/4	Not Determined	0.053	2.1	0.870	0.906	2.10	2.03	4.70
Benzo(g,h,i)perylene	3/4	Not Determined	0.235	0.78	0.314	0.364	0.780	0.815	1.75
Benzo(k)fluoranthene	3/4	Not Determined	0.18	0.68	0.282	0.305	0.680	0.683	1.52
Chrysene	4/4	Not Determined	0.047	2	0.819	0.897	2.00	2.01	4.48
Dibenzo(a,h)anthracene	3/4	Not Determined	0.077	0.37	0.154	0.162	0.370	0.362	0.828
Fluoranthene	4/4	Not Determined	0.2	4.6	1.95	1.87	4.60	4.20	10.3
Fluorene	4/4	Not Determined	0.067	0.92	0.375	0.411	0.920	0.919	2.06
Indeno(1,2,3-cd)pyrene	3/4	Not Determined	0.25	0.89	0.369	0.403	0.890	0.901	1.99
2-Methylnaphthalene	3/4	Not Determined	0.16	0.28	0.102	0.175	0.280	0.392	0.627
Naphthalene	4/4	Not Determined	0.044	5.15	2.31	1.75	5.15	3.91	11.5
Phenanthrene	4/4	Not Determined	0.26	3	1.20	1.35	3.00	3.02	6.72
Pyrene	4/4	Not Determined	0.18	2.9	1.19	1.31	2.90	2.93	6.49
Total PAHs	4/4	Not Determined	1.1685	24.25	9.47	11.9	24.3	26.7	54.3
Pesticides									
4,4'-DDE	3/4	Not Determined	0.0007	0.0022	0.0009	0.0010	0.0022	0.002	0.005
4,4'-DDT	4/4	Not Determined	0.0005	0.0061	0.0027	0.0021	0.0061	0.005	0.014
Dieldrin	3/4	Not Determined	0.0011	0.0024	0.0009	0.0012	0.0024	0.003	0.005
Endosulfan I	1/4	Not Determined	0.0002	0.0002	0.00005	0.0002	0.0002	0.000	0.001
Methoxychlor	4/4	Not Determined	0.0170	0.0280	0.0056	0.0228	0.0280	0.051	0.063
Inorganics									
Antimony	4/4	Not Determined	1.8	2.3	0.222	1.98	2.30	--	--
Chromium	4/4	Not Determined	9.4	39.55	13.2	20.3	39.6	--	--
Cyanide	2/4	Not Determined	0.77	1.565	0.592	0.739	1.57	--	--

a Distributions are characterized, based on dry-weight concentrations, using methods described by D'Agostino *et al.* (1990);

Distributions are "Not Determined" if N<8 or detection frequency<50%;

Distributions are "Undefined" if conditions for normality or log-normality were not met;

Distributions which are "Not Determined" or "Undefined" are assumed to be lognormal for calculation of upperbound EPCs.

b SD = Standard deviation.

c The mean EPC is the arithmetic mean, using one half the detection limit for non-detects.

The upperbound EPC is the maximum level detected.

d Analyte concentrations adjusted to 1% TOC based on an average TOC concentration of 0.45% TOC (dry weight), derived from Lake Erie sediment samples.

DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT

TABLE 3-3

SUMMARY STATISTICS FOR COIs IN SURFACE WATER FOR THE GRAND RIVER

Chemical	Number of Detects	Number of Samples	Detection Frequency	Minimum Detect	Maximum Detect	Distribution ^b	Statistics ^a			RME EPC ^d
							Mean	Standard Deviation	95% UCL (Normal) ^c	
CHROMIUM	242	305	79.3%	0.0012	0.22	UNKNOWN	0.012	0.018	0.013	0.015
HEXAVALENT CHROMIUM	178	295	60.3%	0.002	0.039	UNKNOWN	0.009	0.009	0.009	0.011
HEXAVALENT CHROMIUM, FILTERED	236	300	78.7%	0.003	0.228	UNKNOWN	0.013	0.018	0.013	0.014
TOTAL DISSOLVED SOLIDS	358	358	100.0%	0.00	2940	LOGNORMAL	796.1	397.8	--	--
										2940

- a. Statistics were calculated using one half the method detection limit for nondetects.
 - b. Distributions were "unknown" if N<8 or detection frequency <50% or does not fit a normal or lognormal distribution. "Unknown" distributions were considered lognormal.
 - c. 95% UCL = 95% Upper Confidence Limit. See text for description of calculation methodology.
 - d. RME EPC = Reasonable Maximum Exposure Concentration based on either normal 95% UCL or lognormal 95% UCL, depending on distribution type.
- NA = Not applicable, value exceeds the maximum detected concentration

NOTE: Although other chemicals were detected in Grand River surface water, the list of analytes was focused during the Phase II sampling to the chemicals shown in this table.

DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT

TABLE 3-4
EXPOSURE-POINT CONCENTRATIONS FOR AQUATIC WILDLIFE RECEPTORS OF INTEREST
GRAND RIVER STUDY AREA

COIs	Measured Concentrations		Benthic Invertebrate Biota-Sediment Accumulation Factor ^c BSAF _{bi}	Estimated Concentration In Benthic Invertebrates ^d (mg/kg wet weight) <i>C_{bi}</i>	Forage Fish Biota-Sediment Accumulation Factor ^c BSAF _{fish}	Estimated Concentration In Forage Fish ^a (mg/kg wet weight) <i>C_{fish}</i>
	Sediment EPC ^a (mg/kg dry weight)	Surface Water EPC ^b (mg/L) <i>C_{water}</i>				
Semi/volatile Organic Compounds (SVOCs)						
Bis(2-ethylhexyl)phthalate	0.30	NA	1	0.04	1	0.12
Polycyclic Aromatic Hydrocarbons (PAHs)						
Benzo(a)anthracene	0.24	NA	1.71	0.03	1.71	0.10
Chrysene	0.24	NA	1.71	0.03	1.71	0.10
Fluoranthene	0.3	NA	1.71	0.04	1.71	0.12
2-Methylnaphthalene	0.23	NA	N/A	NE	N/A	NE
Naphthalene	0.96	NA	N/A	NE	N/A	NE
Phenanthrene	0.27	NA	1.71	0.04	1.71	0.11
Pyrene	0.28	NA	1.71	0.04	1.71	0.11
Volatile Organic Compounds (VOCs)						
Benzene	0.12	NA	N/A	NE	N/A	NE
Chlorobenzene	0.02	NA	N/A	NE	N/A	NE
Ethylbenzene	0.12	NA	N/A	NE	N/A	NE
Vinyl Chloride	0.02	NA	N/A	NE	N/A	NE
Pesticides						
Heptachlor Epoxide	0.0021	NA	7.31	0.0003	7.31	0.0008
Metals						
Antimony	4.00	NA	1	0.52	1	1.00
Arsenic	15.7	NA	1	2.04	1	3.93
Barium	88.6	NA	N/A	NE	N/A	NE
Beryllium	0.8	NA	1	0.10	1	0.20
Chromium	51.3	0.015	1	6.67	1	12.8
Copper	15.7	NA	1	2.04	1	3.93

DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT

TABLE 3-4
EXPOSURE-POINT CONCENTRATIONS FOR AQUATIC WILDLIFE RECEPTORS OF INTEREST
GRAND RIVER STUDY AREA

COIs	Measured Concentrations		Benthic Invertebrate Biota-Sediment Accumulation Factor ^c BSAF _{bi}	Estimated Concentration In Benthic Invertebrates ^d (mg/kg wet weight) C_{bi}	Forage Fish Biota-Sediment Accumulation Factor ^e BSAF _{fish}	Estimated Concentration In Forage Fish ^f (mg/kg wet weight) C_{fish}
	Sediment EPC ^a (mg/kg dry weight)	Surface Water EPC ^b (mg/L) C_{water}				
<i>Metals Continued</i>						
Cyanide	2.70	NA		0.35		0.68
Hexavalent Chromium	5.04	0.014		0.66		1.26
Lead	15.1	NA		1.96		3.78
Mercury (Total)	0.5	NA		0.07		0.13
Nickel	18.1	NA		2.35		4.53
Selenium	1.10	NA		0.14		0.28
Vanadium	18.5	NA		2.41		4.63

a From Table 3-1.

b From Table 3-3.

c See Section 3.3.2.1.

d Estimated wet weight concentration in benthic invertebrates (C_{bi}) for organic PCOIs = $BSAF_{bi} \times [C_{sediment} / f_{oc}] \times f_{lipid} \times (DW:WW)$ and for inorganic PCOIs = $BSAF_{bi} \times C_{sediment} \times (DW:WW)$; where $(DW:WW) = 0.13$ representing 87% moisture content in benthic worms (Markwell et al., 1989), $f_{oc} = 0.01$ kg oc/kg sediment, dry weight (Table 2-13), and $f_{lipid} = 0.01$ kg lipid/kg tissue, dry weight (Markwell et al., 1989).

e Estimated wet weight concentration in forage fish (C_{fish}) for organic PCOIs = $BSAF_{fish} \times [C_{sediment} / f_{oc}] \times f_{lipid} \times (DW:WW)$ and for inorganic PCOIs = $BSAF_{fish} \times C_{sediment} \times (DW:WW)$; where $(DW:WW) = 0.25$ representing 75% moisture content in fish (USEPA, 1993a), $f_{oc} = 0.01$ kg oc/kg soil, dry weight (Table 2-10), and $f_{lipid} = 0.016$ kg lipid/kg tissue, dry weight (USEPA, 1997a).

f N/A (not available); BSAFs are not used if the PCOI is not bioaccumulative (i.e., $\log K_{ow} < 4$).

NA (not analyzed); These chemicals were not analyzed in this media.

ND (not detected)

NE (not estimated): concentration is not estimated if the PCOI is not bioaccumulative (i.e., $\log K_{ow} < 4$).
These chemicals were not analyzed in this media.

**DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT**

TABLE 3-5

**PREDICTED VERSUS MEASURED CONCENTRATION (mg/kg) OF METAL COIs
DETECTED IN BIVALVE TISSUE IN THE GRAND RIVER**

Analyte	Predicted (see Table 3-4)	Measured (mean, n=2)	Predicted higher than measured
Cd	0.22	0.15	47%
Cr	6.67	0.26	25x
Pb	1.96	0.105	18x

DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT

TABLE 3-6
EXPOSURE-POINT CONCENTRATIONS FOR AQUATIC WILDLIFE RECEPTORS OF INTEREST
LAKE ERIE SHORELINE STUDY AREA

PCOIs	Measured Concentration In Sediment EPC ^a (mg/kg dry weight) <i>C</i> _{sediment}	Benthic Invertebrate Biota-Sediment Accumulation Factor ^b BSAF _{bi}	Estimated Concentration In Benthic Invertebrates ^c (mg/kg wet weight) <i>C</i> _{bi}	Forage Fish Biota-Sediment Accumulation Factor ^b BSAF _{fish}	Estimated Concentration In Forage Fish ^d (mg/kg wet weight) <i>C</i> _{fish}
			1 N/A	0.08 NE	0.24 NE
Semi/volatile Organic Compounds (SVOCs)					
Bis(2-ethylhexyl)phthalate	0.24		1	0.08	0.24
Carbazole	0.22		N/A	NE	NE
Polyyclic Aromatic Hydrocarbons (PAHs)					
Acenaphthene	0.18	N/A	NE	N/A	NE
Acenaphthylene	0.43	N/A	NE	N/A	NE
Anthracene	1.1	1.71	0.61	1.71	1.88
Benzo(a)anthracene	2.1	1.71	1.17	1.71	3.59
Benzo(a)pyrene	1.6	1.71	0.89	1.71	2.74
Benzo(b)fluoranthene	2.1	1.71	1.17	1.71	3.59
Benzo(g,h,i)perylene	0.78	1.71	0.43	1.71	1.33
Benzo(k)fluoranthene	0.68	1.71	0.38	1.71	1.16
Chrysene	2	1.71	1.11	1.71	3.42
Dibenzo(a,h)anthracene	0.37	1.71	0.21	1.71	0.63
Fluoranthene	4.6	1.71	2.56	1.71	7.87
Fluorene	0.92	1.71	0.51	1.71	1.57
Indeno(1,2,3-cd)pyrene	0.89	1.71	0.49	1.71	1.52
2-Methylnaphthalene	0.28	N/A	NE	N/A	NE
Naphthalene	5.15	N/A	NE	N/A	NE
Phenanthrene	3	1.71	1.67	1.71	5.13
Pyrene	2.9	1.71	1.61	1.71	4.96
Pesticides					
4,4'-DDE	0.002	7.31	0.005	7.31	0.01
4,4'-DDT	0.006	7.31	0.01	7.31	0.04
Dieldrin	0.002	7.31	0.005	7.31	0.01
Endosulfan I	0.0002	N/A	NE	N/A	NE
Methoxychlor	0.028	7.31	0.07	7.31	0.2

DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT

TABLE 3-6
EXPOSURE-POINT CONCENTRATIONS FOR AQUATIC WILDLIFE RECEPTORS OF INTEREST
LAKE ERIE SHORELINE STUDY AREA

PCOIs	Measured Concentration In Sediment (mg/kg dry weight) $C_{sediment}$	Benthic Invertebrate Biota-Sediment Accumulation Factor ^b $BSAF_{bi}$	Estimated Concentration In Benthic Invertebrates ^c (mg/kg wet weight) C_{bi}	Estimated Forage Fish Biota-Sediment Accumulation Factor ^b $BSAF_{fish}$		Estimated Concentration In Forage Fish ^d (mg/kg wet weight) C_{fish}
				Metals	BSAF _{fish}	
Antimony	2.3		1		0.3	1
Chromium	39.6		1		5.15	1
Cyanide	1.57		1		0.2	1

a From Table 3-2.

b See Section 3.4.

c Estimated wet weight concentration in benthic invertebrates (C_b) for organic PCOIs = $BSAF_{bi} \times [C_{sediment} / f_{\infty}] \times f_{lipid} \times (DW:WW)$ and for inorganic PCOIs = $BSAF_{bi} \times C_{sediment} \times (DW:WW)$; where $(DW:WW) = 0.13$ representing 87% moisture content in benthic worms (Markwell et al., 1989), $f_{\infty} = 0.004$ kg oc/kg sediment, dry weight (Table 2-4), and $f_{lipid} = 0.01$ kg lipid/kg tissue, dry weight (Markwell et al., 1989).

d Estimated wet weight concentration in forage fish (C_{fish}) for organic PCOIs = $BSAF_{fish} \times [C_{sediment} / f_{\infty}] \times f_{lipid} \times (DW:WW)$ and for inorganic PCOIs = $BSAF_{fish} \times C_{sediment} \times (DW:WW)$; where $(DW:WW) = 0.25$ representing 75% moisture content in fish (USEPA, 1993a), $f_{\infty} = 0.004$ kg oc/kg soil, dry weight (Table 2-4), and $f_{lipid} = 0.016$ kg lipid/kg tissue, dry weight (USEPA, 1997a).

N/A (not available): BSAFs are not used if the PCOI is not bioaccumulative (i.e., $\log K_{ow} < 4$).

NA(not analyzed): These chemicals were not analyzed in this media.

ND (not detected)

NE (not estimated): concentration is not estimated if the PCOI is not bioaccumulative (i.e., $\log K_{ow} < 4$).
b See Section 3.4.

**DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT**

TABLE 3-7

**COMPARISON OF WHOLE-FISH COI CONCENTRATIONS
ESTIMATED FROM FILLET VS. SEDIMENT DATA FOR THE GRAND RIVER**

COI	Fish Fillet Concentrations ^a (mg/kg wet weight)		Whole-Body Concentrations Estimated From Fillet Data ^b (mg/kg wet weight)		Whole-Body Concentrations Estimated from Sediment Data ^c (mg/kg wet weight)
	Mean	Maximum	Mean	Maximum	
Bis(2-ethylhexyl)phthalate	0.49	0.75	0.59 - 1.13 ^d	0.9 - 1.73 ^d	0.12
Heptachlor epoxide	0.0022	0.0048	0.003 - 0.009 ^d	0.008 - 0.016 ^d	0.0008
Cadmium	0.0044	0.012	0.086	0.086	0.43
Chromium	0.52	1.7	0.62	2.04	13.2
Mercury (Total)	0.14	0.26	0.10	0.16	0.12

a Arithmetic mean and maximum detected concentrations; from Appendix F.

b Whole-body concentrations estimated from fillet data based on extrapolation methods presented in Bevelhimer *et al.* (1997)

Equations:

Lowerbound organic chemical concentration = 1.2 x fillet concentration(Cfillet) (mg/kg wet-weight); method for PCB extrapolation;

Upperbound organic chemical concentration = 2.3 x Cfillet (mg/kg wet-weight); method for PCB extrapolation;

Cadmium concentration = 0.086 (constant value);

Chromium concentration = 1.2 x Cfillet (mg/kg wet-weight); and

Mercury concentration = $\exp[-0.84+0.74*\ln(C\text{fillet})]$.

c Estimated using site-specific sediment concentrations and BSAF_{fish} values; from Table 3-4.

d Range of estimated concentrations. Values are estimated using extrapolation methods for polychlorinated biphenyls and chlordane (Bevelhimer *et al.*, 1997); see Section 3.4.2.3.

DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT

TABLE 3-8

EXPOSURE PARAMETERS FOR WILDLIFE RECEPTORS OF INTEREST^a

General Receptor	Receptor of Interest	Food Ingestion Rate (kg wet weight/day) <i>IR_{food}</i>	% Food Type In Diet				Substrate Ingestion (percent of dry matter intake) <i>IR_{substrate}</i>	Surface Water Ingestion (L/day) <i>IR_{water}</i>	Body Weight (kg) <i>BW</i>	
			Benthic Invertebrates <i>df_{bI}</i>	Forage Fish <i>df_{fish}</i>	Plants <i>df_{plant}</i>	Invertebrates <i>df_{si}</i>				
Piscivorous bird	Belted kingfisher	0.08	13%	87%	NA	NA	0%	0	0.02	0.16
Invertivorous bird	Spotted sandpiper	0.04	100%	0%	NA	NA	18%	0.003	0.007	0.04
Piscivorous mammal	Mink	0.15	15%	85%	NA	NA	0%	0	0.11	1
Invertivorous mammal	Raccoon	1.7	82%	18%	NA	NA	9.4%	0.06	0.57	7

^a From Appendix G (Table G-1).

NA Not applicable.

DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT

TABLE 3-9
AVERAGE DAILY DOSES FOR AQUATIC AVIAN RECEPTORS OF INTEREST
GRAND RIVER STUDY AREA

CQs	Average Daily Dose (mg/kg-day wet weight) ^a					
	Piscivorous Bird Belted Kingfisher			Invertivorous Bird Spotted sandpiper		
	Food	Surface Water	Total	Food	Sediment ^b	Surface Water
Semi-volatile Organic Compounds (SVOCs)						
Bis(2-ethylhexyl)phthalate	0.052	--	0.052	0.04	0.01	--
Polycyclic Aromatic Hydrocarbons (PAHs)						
Benzo(a)anthracene	0.04	--	0.04	0.03	0.009	--
Chrysene	0.044	--	0.044	0.03	0.009	--
Fluoranthene	0.052	--	0.052	0.04	0.01	--
2-Methylnaphthalene	--	--	--	--	0.009	--
Naphthalene	--	--	--	--	0.04	--
Phenanthrene	0.05	--	0.05	0.04	0.01	--
Pyrene	0.05	--	0.05	0.04	0.01	--
Volatile Organic Compounds (VOCs)						
Benzene	--	--	--	--	0.005	--
Chlorobenzene	--	--	--	--	0.0008	--
Ethylbenzene	--	--	--	--	0.005	--
Vinyl Chloride	--	--	--	--	0.0008	--

**DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT**

TABLE 3-9

**AVERAGE DAILY DOSES FOR AQUATIC AVIAN RECEPTORS OF INTEREST
GRAND RIVER STUDY AREA**

cols	Average Daily Dose (mg/kg-day wet weight) ^a						Total	
	Piscivorous Bird Belted Kingfisher			Invertivorous Bird Spotted sandpiper				
	Food	Surface Water	Total	Food	Sediment ^b	Surface Water		
Pesticides								
Heptachlor Epoxide	0.0000348	--	0.0000348	0.0003	0.00008	--	0.0004	
Metals								
Antimony	0.44	--	0.44	0.52	0.15	--	0.67	
Arsenic	1.71	--	1.71	2.04	0.59	--	2.63	
Barium	--	--	--	--	3.3225	--	3.3225	
Beryllium	0.09	--	0.09	0.10	0.03	--	0.13	
Chromium	5.57	0.002	5.57	6.67	1.92	0.003	8.60	
Cyanide	0.296	--	0.296	0.35	0.10	--	0.45	
Hexavalent Chromium	0.548	0.002	0.55	0.66	0.19	0.002	0.85	
Lead	1.64	--	1.64	1.96	0.57	--	2.53	
Mercury (Organic)	0.06	--	0.06	0.02	0.0028	--	0.02	
Mercury (Inorganic) ^c	--	--	--	0.05	0.02	--	0.07	
Mercury (Total)	0.057	--	0.057	0.07	0.019	--	0.089	
Nickel	1.97	--	1.97	2.35	0.68	--	3.03	
Selenium	0.122	--	0.122	0.14	0.04	--	0.18	
Vanadium	2.01	--	2.01	2.41	0.69	--	3.10	

^a See Section 3.4.5 for Equations.

^b Average % moisture in Grand River Study Area sediments is assumed to be approximately 50%.

^c Mercury ADDs are calculated based on apportioning total tissue and sediment mercury concentrations into organic and inorganic forms with ratios specific to food types (25:75 organic to inorganic in benthic invertebrates and 100:0 for fish) and sediment (15:85 organic to inorganic in sediments). See Section 3.3.3.

-- Not a COI in this medium.

DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT

TABLE 3-10

AVERAGE DAILY DOSES FOR AQUATIC MAMMALIAN RECEPTORS OF INTEREST
GRAND RIVER STUDY AREA

COIs	Average Daily Dose (mg/kg-day wet weight) ^a					
	Piscivorous Mammal Mink			Invertivorous Mammal Raccoon		
	Food	Surface Water	Total	Food	Sediment ^b	Surface Water
Semivolatile Organic Compounds (SVOCs)						
Polycyclic Aromatic Hydrocarbons (PAHs)						
Bis(2-ethylhexyl)phthalate	0.02	--	0.02	0.01	0.001	--
Benzo(a)anthracene	0.01	--	0.01	0.006	0.001	--
Chrysene	0.01	--	0.01	0.006	0.001	--
Fluoranthene	0.02	--	0.02	0.01	0.001	--
2-Methylnaphthalene	--	--	--	--	0.001	--
Naphthalene	--	--	--	--	0.004	--
Phenanthrene	0.01	--	0.01	0.01	0.001	--
Pyrene	0.01	--	0.01	0.01	0.001	--
Volatile Organic Compounds (VOCs)						
Benzene	--	--	--	--	0.0005	--
Chlorobenzene	--	--	--	--	8.6E-05	--
Ethylbenzene	--	--	--	--	0.0005	--
Vinyl Chloride	--	--	--	--	8.6E-05	--
Pesticides						
Heptachlor Epoxide	0.0001	--	0.0001	6.0E-05	9.0E-06	--
						6.9E-05

DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT

TABLE 3-10
AVERAGE DAILY DOSES FOR AQUATIC MAMMALIAN RECEPTORS OF INTEREST
GRAND RIVER STUDY AREA

COIs	Average Daily Dose (ng/kg-day wet weight) ^a						Invertivorous Mammal Raccoon	
	Piscivorous Mammal Mink			Invertivorous Mammal Raccoon				
	Food	Surface Water	Total	Food	Sediment ^b	Surface Water		
<i>Metals</i>								
Antimony	0.1275	--	0.128	0.10	0.02	--	0.12	
Arsenic	0.50	--	0.50	0.41	0.07	--	0.47	
Barium	--	--	--	--	0.379714286	--	0.379714286	
Beryllium	0.03	--	0.03	0.02	0.003	--	0.02	
Chromium	1.63	0.002	1.63	1.33	0.22	0.001	1.55	
Cyanide	0.09	--	0.09	0.07	0.01	--	0.08	
Hexavalent Chromium	0.16	0.002	0.16	0.13	0.02	0.001	0.15	
Lead	0.48	--	0.48	0.39	0.06	--	0.46	
Mercury (Organic) c	0.02	--	0.02	0.003	0.0003	--	0.004	
Mercury (Inorganic) c	--	--	--	0.01	0.002	--	0.01	
Mercury (Total)	0.017	--	0.017	0.014	0.002	--	0.016	
Nickel	0.58	--	0.58	0.47	0.08	--	0.55	
Selenium	0.04	--	0.04	0.03	0.005	--	0.03	
Vanadium	0.59	--	0.59	0.48	0.08	--	0.56	

^a See Section 3-4.5 for Equations.

^b Average 2% moisture in Grand River Study Area sediments is assumed to be approximately 50%.

c Mercury ADDs are calculated based on apportioning total tissue and sediment mercury concentrations into organic and inorganic forms with ratios specific to food types (25:75 organic to inorganic in benthic invertebrates and 100:0 for fish) and sediment (15:85 organic to inorganic in sediments). See Section 3.3.3.

-- Not a COI in this medium.

DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT

TABLE 3-11

**AVERAGE DAILY DOSES FOR AQUATIC AVIAN RECEPTORS OF INTEREST
LAKE ERIE SHORELINE STUDY AREA**

PCoIs	Average Daily Dose (mg/kg-day wet weight) ^a				
	Piscivorous Bird Belted Kingfisher		Invertivorous Bird Spotted sandpiper		
	Food	Total	Food	Sediment ^b	Total
Semivolatile Organic Compounds (SVOCs)					
Bis(2-ethylhexyl)phthalate	0.12	0.12	0.08	0.01	0.09
Carbazole	--	--	--	0.01	0.01
Polycyclic Aromatic Hydrocarbons (PAHs)					
Acenaphthene	--	--	--	0.01	0.01
Acenaphthylene	--	--	--	0.03	0.03
Anthracene	0.94	0.94	0.61	0.06	0.67
Benzo(a)anthracene	1.80	1.80	1.17	0.12	1.29
Benzo(a)pyrene	1.37	1.37	0.89	0.09	0.98
Benzo(b)fluoranthene	1.80	1.80	1.17	0.12	1.29
Benzo(g,h,i)perylene	0.67	0.67	0.43	0.05	0.48
Benzo(k)fluoranthene	0.58	0.58	0.38	0.04	0.42
Chrysene	1.71	1.71	1.11	0.12	1.23
Dibenz(a,h)anthracene	0.32	0.32	0.21	0.02	0.23
Fluoranthene	3.94	3.94	2.56	0.27	2.83
Fluorene	0.79	0.79	0.51	0.05	0.56
Indeno(1,2,3-cd)pyrene	0.76	0.76	0.49	0.05	0.54
2-Methylnaphthalene	--	--	--	0.02	0.02
Naphthalene	--	--	--	0.30	0.30
Phenanthrene	2.57	2.57	1.67	0.18	1.85
Pyrene	2.48	2.48	1.61	0.17	1.78

DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT

TABLE 3-11

AVERAGE DAILY DOSES FOR AQUATIC AVIAN RECEPTORS OF INTEREST
LAKE ERIE SHORELINE STUDY AREA

PCOs	Average Daily Dose (mg/kg-day wet weight) ^a				
	Piscivorous Bird		Invertivorous Bird		
	Belted kingfisher		Spotted sandpiper		
Food	Total	Food	Sediment ^b		Total
			Pesticides		
4,4'-DDE	0.005	0.005	0.005	0.0001	0.005
4,4'-DDT	0.02	0.02	0.01	0.0004	0.010
Dieldrin	0.005	0.005	0.005	0.0001	0.005
Endosulfan I	--	--	--	1.E-05	1.E-05
Methoxychlor	0.10	0.10	0.07	0.002	0.07
			Metals		
Antimony	0.29	0.29	0.3	0.13	0.43
Chromium	4.95	4.95	5.15	2.32	7.47
Cyanide	0.20	0.20	0.2	0.09	0.29

a See Section 3.4.5 for Equations.

b Average % moisture in Lake Erie Shoreline Study Area sediments = 22% (Table 2-13).

-- Not a COI in this medium.

DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT

TABLE 3-12
AVERAGE DAILY DOSES FOR AQUATIC MAMMALIAN RECEPTORS OF INTEREST
LAKE ERIE SHORELINE STUDY AREA

PCOs	Average Daily Dose (mg/kg-day wet weight) ^a				
	Piscivorous Mammal Mink		Invertivorous Mammal Raccoon		
	Food	Total	Food	Sediment ^b	Total
<i>Semi/volatile Organic Compounds (SVOCs)</i>					
Bis(2-ethylhexyl)phthalate	0.04	0.04	0.02	0.002	0.021
Carbazole	--	--	--	0.001	0.00
<i>Polycyclic Aromatic Hydrocarbons (PAHs)</i>					
Acenaphthene	--	--	--	0.001	0.001
Acenaphthylene	--	--	--	0.003	0.003
Anthracene	0.28	0.28	0.15	0.007	0.16
Benzo(a)anthracene	0.54	0.54	0.28	0.01	0.30
Benzo(a)pyrene	0.41	0.41	0.22	0.01	0.23
Benzo(b)fluoranthene	0.54	0.54	0.28	0.01	0.30
Benzo(g,h,i)perylene	0.20	0.20	0.10	0.005	0.11
Benzo(k)fluoranthene	0.17	0.17	0.09	0.005	0.10
Chrysene	0.51	0.51	0.27	0.01	0.28
Dibenz(a,h)anthracene	0.09	0.09	0.05	0.002	0.05
Fluoranthene	1.18	1.18	0.62	0.03	0.65
Fluorene	0.24	0.24	0.12	0.006	0.13
Indeno(1,2,3-cd)pyrene	0.23	0.23	0.12	0.006	0.12
2-Methylnaphthalene	--	--	--	0.002	0.002
Naphthalene	--	--	--	0.03	0.03
Phenanthrene	0.77	0.77	0.41	0.02	0.43
Pyrene	0.74	0.74	0.39	0.02	0.41

DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT

TABLE 3-12

AVERAGE DAILY DOSES FOR AQUATIC MAMMALIAN RECEPTORS OF INTEREST
LAKE ERIE SHORELINE STUDY AREA

PCOIs	Average Daily Dose (mg/kg-day wet weight) ^a				
	Piscivorous Mammal Mink		Invertivorous Mammal Raccoon		
	Food	Total	Food	Sediment ^b	Total
<i>Pesticides</i>					
4,4'-DDE	0.002	0.002	0.001	1E-05	0.001
4,4'-DDT	0.006	0.006	0.002	4E-05	0.002
Dieldrin	0.002	0.002	0.001	1E-05	0.001
Endosulfan I	--	--	--	1E-06	1E-06
Methoxychlor	0.03	0.03	0.02	0.0002	0.02
<i>Metals</i>					
Antimony	0.09	0.09	0.07	0.02	0.09
Chromium	1.49	1.49	1.25	0.26	1.52
Cyanide	0.06	0.06	0.05	0.01	0.06

a See Section 3.4.5 for Equations.

b Average % moisture in Lake Erie Shoreline Study Area sediments = 22% (Table 2-13).

-- Not a COI in this medium.

**DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT**

TABLE 4-1

SEDIMENT QUALITY GUIDELINES (SQGs) FOR SELECT PAHs (mg/kg)

Chemical (mg/kg)	TEC ^a	PEC ^b
Naphthalene	0.176	0.561
Acenaphthene	NA ^c	NA
Acenaphthylene	NA	NA
Anthracene	0.0572	0.845
Benzo(a)pyrene	0.15	1.45
Benzo(b)fluoranthene	NA	NA
Benzo(k)fluoranthene	NA	NA
Chrysene	0.166	1.29
Floranthene	0.423	2.23
Fluorene	0.0774	0.536
Phenanthren	0.204	1.17
Pyrene	0.195	1.52
Benzo(a)anthracene	0.108	1.05
Total PAH	1.61	22.8

a. TEC - Threshold Effect Concentration

b. PEC - Probable Effects Concentration

Source of TEC and PEC values is MacDonald et al. (2000).

NA = Not Available

DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT

TABLE 4-2

SEDIMENT SCREENING BENCHMARKS FOR ORGANIC PCOIs DERIVED USING THE EQUILIBRIUM PARTITIONING APPROACH
AND THE CONSENSUS-BASED APPROACH

Chemical	Coefficients ^a			Chronic Water Quality Benchmark ^b (mg/L)		Chronic SQB ^c (mg/kg at 1% TOC)		SQG ^e mg/kg	
	Log K _{ow}	Log K _{oc}	K _{oc}	TEC	PEC	TEC	PEC	TEC	PEC
Semi-volatile Organic Compounds (SVOCs)									
Bis(2-Ethylhexyl)Phthalate	7.30	7.18	15135612	not applicable	not calculated	NA	NA	NA	NA
Carbazole	3.59	3.53	3388	#REF!	#REF!	NA	NA	NA	NA
Volatile Organic Compounds (VOCs)									
Benzene	2.13	2.09	123	#REF!	#REF!	NA	NA	NA	NA
Chlorobenzene	2.86	2.81	646	#REF!	#REF!	NA	NA	NA	NA
Ethylbenzene	3.14	3.09	1230	#REF!	#REF!	NA	NA	NA	NA
Vinyl Chloride	1.50	1.47	29.5	not applicable	not calculated	NA	NA	NA	NA
Pesticides									
4,4'-DDE	6.76	6.65	4466836	not applicable	not calculated	0.0032	0.0313	0.0042	0.0629
4,4'-DDT	6.53	6.42	2630268	not applicable	not calculated	0.052 ^d	0.0019	0.0029	0.0618
Dieldrin	5.37	5.28	190546	#REF!	#REF!	NA	NA	NA	NA
Endosulfan I	3.83	3.77	5888	#REF!	#REF!	0.0025	0.016	0.019	0.016
Heptachlor epoxide	5.00	4.92	83176	#REF!	#REF!	NA	NA	NA	NA
Methoxychlor	5.08	4.99	97724	#REF!	#REF!	0.019	0.019	0.019	0.019

a Partitioning coefficients:

Log K_{ow} = Base-10 logarithm of the octanol:water partitioning coefficient from Karrickhoff and Long (1985);
K_{oc} = coefficient for sorption to organic carbon, calculated as log K_{oc} = 0.00028 + 0.983log K_{ow} (Di Toro *et al.*, 1991).

b Water quality screening benchmarks from Table 4-4.

c Sediment quality benchmark (SQB), normalized to 1% TOC, for nonpolar organic chemicals with Log K_{ow} greater than 2 and less than 5.5;

d USEPA Proposed Sediment Quality Criteria (USEPA, 1996b).

e Consensus based sediment quality guidelines (SQG), Threshold Effects Concentration (TEC), and Probable Effects Concentration (PEC), (MacDonald *et al.*, 2000)

**DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT**

TABLE 4-3

NOAA AND OME SEDIMENT SCREENING BENCHMARKS FOR INORGANIC COIs

Chemical	NOAA Guidelines^a		OME Guidelines^b		SQG^c	
	(mg/kg) ER-L	(mg/kg) LEL	(mg/kg) LEL	TEC	mg/kg	PEC
Antimony	2	none available	none available	none available	none available	none available
Arsenic	33	6	9.79		33	
Barium	none available	none available	none available	none available	none available	
Beryllium	none available	none available	none available	none available	none available	
Chromium, Total	80	26	43.4		111	
Chromium, Hexavalent	none available	none available	none available	none available	none available	
Cyanide	none available	none available	none available	none available	none available	
Lead	35	31	35.8		128	
Mercury	0.15	0.2	0.18		1.06	
Nickel	30	16	22.7		48.6	
Selenium	none available	none available	none available	none available	none available	
Vanadium	none available	none available	none available	none available	none available	

a NOAA (National Oceanic and Atmospheric Administration) sediment quality benchmarks (Long and Morgan, 1991; Long et al., 1995).

b OME (Ontario Ministry of the Environment) values (mg/kg dry weight), normalized to 1% TOC (organic only); LEL = Lowest Effects Level.

c Consensus based sediment quality guidelines (SQG), Threshold Effects Concentration (TEC), and Probable Effects Concentration (PEC), (MacDonald et al., 2000).

DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT

TABLE 4-4

SCREENING BENCHMARKS FOR SURFACE WATER QUALITY

Chemical of Interest	Medium of Interest	OMZM Water Quality Screening Benchmarks (mg/L)		OMZM Water Quality Screening Benchmarks (mg/L)	Benchmarks Type ^a	Benchmark Reference
		Benchmarks (mg/L)	Type ^a			
Semivolatile Organic Compounds (SVOCs)						
Chromium, Trivalent	GR Surface Water	0.14 ^c		2.98 ^c	TIER I	OAC 3745-1-07
Chromium, Hexavalent (Filtered)	GR Surface Water	0.011		0.016	TIER I	OAC 3745-1-07
Chromium, Hexavalent (Unfiltered)	GR Surface Water	0.011		0.016	TIER I	OAC 3745-1-07
Dissolved Solids	GR Surface Water	1500	Other	none available	TIER I	OAC 3745-1-07

NOTES:

AWQC = USEPA national ambient water quality criteria.

FAV = Final Acute Value, calculated by the USEPA for use in the derivation of sediment-quality criteria.

FCV = Final Chronic Value, calculated by the USEPA for use in the derivation of sediment-quality criteria.

LOEC = Lowest observed effects concentration.

OMZA = "Outside the Mixing Zone Average" OMZM = "Outside the Mixing Zone Maximum (OAC 3745-1-07), Tier I = Aquatic Life Criteria

Tier II = chronic screening value (SCV) and secondary acute value (SAV) for fish and aquatic invertebrates.

a Surface water benchmarks for sediment CQIs are used to calculate sediment quality benchmarks.

b Calculated using AQUIRE data and Tier II calculation methods presented in Suter and Tsao (1996).

c Hardness-dependent criteria, based on a maximum hardness value of 178 (mg/L CaCO₃).

d Temperature- and pH-dependent criteria, based on the most conservative temperature of (30 °C) and a pH of 7.7 (s.u.). See Table 2-13 for average pH value.

Table 4-5
Uncertainty and Extrapolation Factors used in the Derivation of TRVs

Adjustment Type	Adjustment	Factor
Dose-Matrix Extrapolation Factor:	Water Matrix to Food Matrix	3 (lead only)
Duration Uncertainty Factor:	Subchronic to Chronic	3
	Acute to Chronic	8
Endpoint Uncertainty Factor:	LOAEL _t to NOAEL _t	10
	FEL _t to NOAEL _t	50
	FEL _t to LOAEL _t	5
Body-Weight Extrapolation Factor:	NOAEL _t to NOAEL _w , or LOAEL _t to LOAEL _w	$(BW_t/BW_w)^{0.25}$ (mammals only)

LOAEL_t = Lowest observed adverse effect level in a test species.

NOAEL_t = No observed adverse effect level in a test species.

FEL_t = Frank effect level in a test species.

NOAEL_w = No observed adverse effect level in a wildlife species.

LOAEL_w = Lowest observed adverse effect level in a wildlife species.

BW_t = Body weight of the test species.

BW_w = Body weight of the wildlife ROI.

Table 4-6
Exposure Parameter Values for Mammalian and Avian Test Species

Test Species	Body Weight (kg)	Reference	Food Ingestion Rate (kg/day)	Water Ingestion Rate (L/day)
Laboratory Mouse	0.03	USEPA (1985b)	0.006 ^a	0.008 ^b
Laboratory Rat	0.35	USEPA (1985b)	0.03 ^a	0.05 ^b
Laboratory Rat (juvenile)	0.17	Schlicker and Cox (1968)	0.02 ^a	0.03 ^b
Beagle Dog	14	USEPA (1988d)	0.32 ^a	0.7 ^b
Mink	1	USEPA (1993d)	0.15 ^c	0.11 ^d
Rabbit	3.8	USEPA (1985b)	0.14 ^a	0.27 ^b
Rhesus Monkey	10.5	USEPA (1988d)	0.27 ^a	0.57 ^b
Rhesus Monkey (juvenile)	5	Barsotti et al. (1976)	0.16 ^a	0.33 ^b
Oldfield Mouse	0.01	Silvia and Downing (1995)	0.003 ^a	0.003 ^b
White-footed Mouse	0.02	Linzey (1987)	0.003 ^e	0.006 ^b
Deer Mouse	0.02	Millar (1989) ^e	0.004 ^a	0.006 ^b
Guinea Pig	0.86	USEPA (1988d)	0.05 ^a	0.09 ^b
Chicken	1.5	USEPA (1988d)	0.38 ^f	0.08 ^g
Chicken (chick: 14 days)	0.12	USEPA (1988d)	0.07 ^f	0.01 ^g
Brown Pelican	3.5	Dunning (1984)	0.66 ^h	0.14 ^g
Black Duck	1.25	Dunning (1984)	0.34 ^f	0.07 ^g
Mallard	1.13	USEPA (1993a) ^h	0.32 ^f	0.06 ^g
American Kestrel	0.13	Pattee (1984)	0.01 ⁱ	0.02 ^g
Screech Owl	0.18	Dunning (1984)	0.1 ^f	0.02 ^g
Japanese Quail	0.15	Vos et al. (1971)	0.08 ^f	0.02 ^g
Ringed Dove	0.16	Terres (1991)	0.09 ^f	0.02 ^g
Barn Owl	0.47	Johnsgard (1988) ^j	0.06 ^f	0.04 ^g
Red-winged Blackbird	0.06	Stickel et al. (1983)	0.05 ^f	0.009 ^g
Gray Partridge	0.4	Abiola (1992) ^e	0.16 ^f	0.03 ^g

a Estimated food ingestion rate for mammalian laboratory test species = $(0.056(\text{Body Weight in kg})^{0.661})$ (USEPA, 1988d).

b Estimated water ingestion rate for mammalian laboratory test species = $(0.10(\text{Body Weight in kg})^{0.7377})$ (USEPA, 1988d).

c Estimated food ingestion rate (kg/day) = Ingestion Rate_{food} (g/g-day) × Body Weight, where the ingestion rate for the mink = 0.15 g/g-day (USEPA, 1993a).

d Estimated water ingestion rate (L/day) = Ingestion Rate_{water} (g/g-day) × Body Weight, where the ingestion rate for the mink = 0.11 g/g-day (USEPA, 1993a).

e Cited in Opresko et al. (1994).

f Estimated food ingestion rate for avian test species = $(0.0582(\text{Body Weight in kg})^{0.651}) / 0.2$ (Nagy, 1987)
 where 0.2 = dry weight to wet weight conversion factor (assuming 80% moisture in test species diets).

g Estimated water ingestion rate for avian test species = $(0.059(\text{Body Weight in kg})^{0.67})$ (Calder and Braun, 1983).

h Mean body weight for North American male and female mallards based on information reported in USEPA (1993a).

i From Kenaga (1973) cited in Sample et al. (1996).

j Cited in Sample et al. (1996).

Table 4-7
Body-Weight Extrapolation Factors for Mammalian Receptors of Interest

Test Species		Wildlife ROI		Body-Weight
Species	Body Weight ^a (BW _t) (kg)	Species	Body Weight ^b (BW _w) (kg)	Extrapolation Factor ^c
Laboratory Mouse	0.03	Mink	1	0.42
Laboratory Rat	0.35			0.77
Beagle Dog	14.0			1.93
Mink	1			1
Rabbit	3.8			1.4
Rhesus Monkey	10.5			1.80
Oldfield Mouse	0.014			0.34
White-footed Mouse	0.02			0.38
Deer Mouse	0.02			0.38
Guinea Pig	0.86			0.96
Laboratory Mouse	0.03	Raccoon	7	0.26
Laboratory Rat	0.35			0.47
Beagle Dog	14.0			1.19
Mink	1			0.61
Rabbit	3.8			0.86
Rhesus Monkey	10.5			1.11
Oldfield Mouse	0.014			0.21
White-footed Mouse	0.02			0.23
Deer Mouse	0.02			0.23
Guinea Pig	0.86			0.59
Laboratory Mouse	0.03	Meadow Vole	0.04	0.93
Laboratory Rat	0.35			1.72
Beagle Dog	14.0			4.33
Mink	1			2.24
Rabbit	3.8			3.12
Rhesus Monkey	10.5			4.03
Oldfield Mouse	0.014			0.77
White-footed Mouse	0.02			0.84
Deer Mouse	0.02			0.84
Guinea Pig	0.86			2.15
Laboratory Mouse	0.03	Short-tailed Shrew	0.02	1.11
Laboratory Rat	0.35			2.05
Beagle Dog	14.0			5.14
Mink	1			2.66
Rabbit	3.8			3.71
Rhesus Monkey	10.5			4.79
Oldfield Mouse	0.014			0.91
White-footed Mouse	0.02			1
Deer Mouse	0.02			1
Guinea Pig	0.86			2.56
Laboratory Mouse	0.03	Red Fox	4.74	0.28
Laboratory Rat	0.35			0.52
Beagle Dog	14.0			1.31

Table 4-7
Body-Weight Extrapolation Factors for Mammalian Receptors of Interest

Test Species		Wildlife ROI	Body-Weight Extrapolation Factor ^c
Species	Body Weight ^a (BW _t) (kg)	Species	
Mink	1		0.68
Rabbit	3.8		0.95
Rhesus Monkey	10.5		1.22
Oldfield Mouse	0.014		0.23
White-footed Mouse	0.02		0.25
Deer Mouse	0.02		0.25
Guinea Pig	0.86		0.65

a From Table 4-6.

b Appendix G.

c Body-weight extrapolation factor = (BW_t/BW_w)0.25 (Sample *et al.* 1996).

Table 4-8
Derivation of Chronic NOAEL Toxicity Reference Values (TRVs) for Avian Receptors of Interest
 (Page 1 of 3)

Chemical	Study Description and Source	Test Species		Dose Matrix	Duration	Endpoint	NOAEL TRV for Birds ^d (mg/kg-day)
		Dose (mg/kg-day)	EF ^a				
Semivolatile Organic Compounds (SVOCs)							
Bis(2-ethylhexyl)phthalate	Chronic NOAEL (critical life stage) for reproduction in ringed doves (Peakall, 1974).	5.63	diet	1	1	1	5.63
Carbazole	--	--	--	--	--	--	--
Dibenzofuran	Acute LOAEL for mortality in red-winged blackbirds (Schafer <i>et al.</i> , 1983).	102	gavage	1	8	10	1.28
Polycyclic Aromatic Hydrocarbons (PAHs)							
Acenaphthene	Acute LOAEL for mortality in red-winged blackbirds estimated following 18 hr. food consumption of acenaphthene (Schafer <i>et al.</i> , 1983)	101	diet	1	8	10	1.26
Acenaphthylene	Chronic NOAEL for mortality effects in mallards dosed with a PAH mixture (Patton and Dieter, 1980).	1077	diet	1	1	1	1077
Anthracene	Acute LOAEL for mortality in red-winged blackbirds estimated following consumption of anthracene (Schafer <i>et al.</i> , 1983)	111	diet	1	8	10	1.39
Benzo(a)anthracene	Chronic NOAEL for mortality effects in mallards dosed with a PAH mixture (Patton and Dieter, 1980).	1077	diet	1	1	1	1077
Benzo(a)pyrene	Chronic NOAEL for mortality effects in mallards dosed with a PAH mixture (Patton and Dieter, 1980).	1077	diet	1	1	1	1077
Benzo(b)fluoranthene	Chronic NOAEL for mortality effects in mallards dosed with a PAH mixture (Patton and Dieter, 1980).	1077	diet	1	1	1	1077
Benzo(g,h,i)perylene	Chronic NOAEL for mortality effects in mallards dosed with a PAH mixture (Patton and Dieter, 1980).	1077	diet	1	1	1	1077
Benzo(k)fluoranthene	Chronic NOAEL for mortality effects in mallards dosed with a PAH mixture (Patton and Dieter, 1980).	1077	diet	1	1	1	1077
Chrysene	Chronic NOAEL for mortality effects in mallards dosed with a PAH mixture (Patton and Dieter, 1980).	1077	diet	1	1	1	1077
Dibenzo(a,h)anthracene	Chronic NOAEL for mortality effects in mallards dosed with a PAH mixture (Patton and Dieter, 1980).	1077	diet	1	1	1	1077
Fluoranthene	Chronic NOAEL for mortality effects in mallards dosed with a PAH mixture (Patton and Dieter, 1980).	1077	diet	1	1	1	1077
Fluorene	Acute LOAEL for mortality in red-winged blackbirds, estimated from 18 hr. consumption of feed treated with fluorene (Schafer <i>et al.</i> , 1983).	101	diet	1	8	10	1.26
Indeno(1,2,3-cd)Pyrene	Chronic NOAEL for mortality effects in mallards dosed with a PAH mixture (Patton and Dieter, 1980).	1077	diet	1	1	1	1077
2-Methylnaphthalene	Chronic NOAEL for mortality effects in mallards dosed with a PAH mixture (Patton and Dieter, 1980).	1077	diet	1	1	1	1077
Naphthalene	Chronic NOAEL for mortality effects in mallards dosed with a PAH mixture (Patton and Dieter, 1980).	1077	diet	1	1	1	1077
Phenanthrene	Acute LOAEL for mortality in red-winged blackbirds (Schafer <i>et al.</i> , 1983).	113	gavage	1	8	10	1.41
Pyrene	Chronic NOAEL for mortality effects in mallards dosed with a PAH mixture (Patton and Dieter, 1980).	1077	diet	1	1	1	1077

Table 4-8
Derivation of Chronic NOAEL Toxicity Reference Values (TRVs) for Avian Receptors of Interest
(Page 2 of 3)

Chemical	Study Description and Source	Test Species		Dose Matrix	Duration	Endpoint	NOAEL TRV for Birds ^d (mg/kg-day)
		Dose (mg/kg-day)	EF ^a				
Volatile Organic Compounds (VOCs)							
Benzene	--	--	--	--	--	--	--
Chlorobenzene	--	--	--	--	--	--	--
Ethylbenzene	--	--	--	--	--	--	--
Vinyl Chloride	--	--	--	--	--	--	--
Pesticides							
4,4'-DDE	Chronic LOAEL for reproductive effects in barn owls (Mendenhall <i>et al.</i> , 1983 cited in WHO, 1989a).	0.38	diet	1	1	10	0.04
4,4'-DDT	Chronic LOAEL for reproductive effects in brown pelicans (Anderson <i>et al.</i> , 1975).	0.03	diet	1	1	10	0.003
Dieldrin	Chronic NOAEL for reproductive effects in barn owls (Mendenhall <i>et al.</i> , 1983 cited in Sample <i>et al.</i> , 1996).	0.07	diet	1	1	1	0.07
Endosulfan I	Chronic (critical life stage) NOAEL for reproductive effects in gray partridge (Abiola, 1992 cited in Sample <i>et al.</i> , 1996).	50	diet	1	1	1	50
Endrin Aldehyde	Chronic (critical life stage) LOAEL for reproductive effects in screech owls dosed with endrin (Fleming <i>et al.</i> , 1982 cited in Sample <i>et al.</i> , 1996).	0.42	diet	1	1	10	0.04
Heptachlor	Chronic (critical life stage) NOAEL for reproductive effects in Japanese quail (Shellenberger <i>et al.</i> , 1966 cited in WHO, 1984).	26.7	diet	1	1	1	26.7
Heptachlor Epoxide	Chronic NOAEL for reproductive effects (reduced hatchability and chick viability) in chickens (Wolvin <i>et al.</i> , 1969 cited in WHO, 1984).	0.005	diet	1	1	1	0.005
Methoxychlor	Acute LOAEL for mortality in mallard, sharp-tailed grouse and California quail (Hudson <i>et al.</i> , 1984).	2000	diet	1	8	10	25
Polychlorinated Biphenyls (PCBs)							
PCB-1254	Chronic LOAEL for reproductive effects in ring-necked pheasants (Dahlgren <i>et al.</i> , 1972).	1.8	oral capsule	1	1	10	0.18
PCB-1260	Chronic (critical life stage) NOAEL for reproductive effects in Japanese quail (Call and Harrell, 1974).	33.3	diet	1	1	1	33.3

Table 4-8
Derivation of Chronic NOAEL Toxicity Reference Values (TRVs) for Avian Receptors of Interest
 (Page 3 of 3)

Chemical	Study Description and Source	Test Species		Dose			Endpoint EF ^c	NOAEL TRV for Birds ^d (mg/kg-day)
		Dose (mg/kg-day)	Dose Matrix	EF ^a	EF ^b	Duration		
Metals								
Aluminum	Chronic NOAEL for reproductive effects in ringed dove (Carriere <i>et al.</i> , 1986).	563	diet	1	1	1		563
Antimony	--	--	--	--	--	--		--
Arsenic	Chronic NOAEL for mortality in mallards (USFWS, 1964 cited in Sample <i>et al.</i> , 1996).	14.5	diet	1	1	1		14.5
Beryllium	--	--	--	--	--	--		--
Cadmium	Chronic NOAEL for reproductive effects in mallards (White and Finley, 1978).	1.45	diet	1	1	1		1.45
Chromium, Trivalent	Chronic NOAEL for reproductive effects in black ducks (Haseltine <i>et al.</i> , unpub. data, reported in Sample <i>et al.</i> , 1996).	2.72	diet	1	1	1		2.72
Chromium, Hexavalent	Subchronic NOAEL for mortality and growth effects in chickens (Romoser <i>et al.</i> , 1961).	58.3	diet	1	3	1		19.4
Cobalt	--	--	--	--	--	--		--
Copper	Chronic NOAEL for developmental (growth) effects in 14-day old chickens (Mehring <i>et al.</i> , 1980).	333	diet	1	1	1		333
Cyanide	Subchronic NOAEL for survival, growth and systemic effects in chickens (Gomez <i>et al.</i> , 1988).	26.1	diet	1	3	1		8.7
Lead	Chronic NOAEL for survival and reproductive effects in American kestrels (Pattee, 1984).	4.15	diet	1	1	1		4.15
Mercury (Inorganic)	Chronic (critical life stage) NOAEL for reproductive and developmental effects in Japanese quail (Hill and Schaffner, 1976).	2.13	diet	1	1	1		2.13
Mercury (Organic)	Chronic (critical life stage) NOAEL for mortality effects in Japanese quail (Hill and Soares 1984).	2.13	diet	1	1	1		2.13
Nickel	Chronic NOAEL for mortality and growth effects in mallard ducklings (Cain and Pafford, 1981).	219	diet	1	1	1		219
Selenium	Chronic NOAEL for reproductive effects in mallards (Heinz <i>et al.</i> , 1987 cited in Sample <i>et al.</i> , 1996).	0.4	diet	1	1	1		0.4
Silver	--	--	--	--	--	--		--
Thallium	LD50 for mortality in ring-necked pheasants (Hudson <i>et al.</i> , 1984).	23.7	oral	1	8	50		0.06
Vanadium	Subchronic NOAEL for mortality effects in chickens (Romoser <i>et al.</i> , 1961).	70	diet	1	3	1		23.3

a Dose-Matrix EF (extrapolation factor); see Section 4.4.2.2.

b Duration UF (uncertainty factor); see Section 4.4.2.3.

c Endpoint UF (uncertainty factor); see Section 4.4.2.4.

d TRV = (test-species dose × dose matrix EF) ÷ (Duration UF × Endpoint UF).

-- Appropriate data are not available from published literature to derive Toxicity Reference Values.

NOAEL = No Observable Adverse Effects Level

Note: A larger TRV list is presented within this table than was used in the ecological risk assessment.

Table 4-9
Derivation of Chronic LOAEL Toxicity Reference Values (TRVs) for Avian Receptors of Interest
(Page 1 of 2)

Chemical	Study Description and Source	Test Species		Dose Matrix	Duration	Endpoint	LOAEL TRV for Birds ^d (mg/kg-day)
		Dose (mg/kg-day)	EF ^a				
Semivolatile Organic Compounds (SVOCs)							
Bis(2-ethylhexyl)phthalate	--	--	--	--	--	--	--
Carbazole	--	--	--	--	--	--	--
Dibenzofuran	Acute LOAEL for mortality in red-winged blackbirds (Schafer <i>et al.</i> , 1983).	102	gavage	1	8	1	12.8
Polycyclic Aromatic Hydrocarbons (PAHs)							
Acenaphthylene	--	--	--	--	--	--	--
Anthracene	Acute LOAEL for mortality in red-winged blackbirds (Schafer <i>et al.</i> , 1983)	111	diet	1	8	1	13.9
Benzo(a)anthracene	--	--	--	--	--	--	--
Benzo(a)pyrene	--	--	--	--	--	--	--
Benzo(b)fluoranthene	--	--	--	--	--	--	--
Benzo(g,h,i)Perylene	--	--	--	--	--	--	--
Benzo(k)Fluoranthene	--	--	--	--	--	--	--
Chrysene	--	--	--	--	--	--	--
Dibenzo(a,h)anthracene	--	--	--	--	--	--	--
Fluoranthene	--	--	--	--	--	--	--
Fluorene	Acute LOAEL for mortality in red-winged blackbirds, estimated from 18 hr. consumption of feed treated with fluorene (Schafer <i>et al.</i> , 1983).	101	diet	1	8	1	12.6
Indeno(1,2,3-cd)Pyrene	--	--	--	--	--	--	--
2-Methylnaphthalene	--	--	--	--	--	--	--
Naphthalene	--	--	--	--	--	--	--
Phenanthrene	Acute LOAEL for mortality in red-winged blackbirds (Schafer <i>et al.</i> , 1983).	113	gavage	1	8	1	14.1
Pyrene	--	--	--	--	--	--	--
Volatile Organic Compounds (VOCs)							
Benzene	--	--	--	--	--	--	--
Chlorobenzene	--	--	--	--	--	--	--
Ethylbenzene	--	--	--	--	--	--	--
Vinyl Chloride	--	--	--	--	--	--	--
Pesticides							
4,4'-DDE	Chronic LOAEL for reproductive effects in barn owls (Mendenhall <i>et al.</i> , 1983 cited in WHO, 1989a).	0.38	diet	1	1	1	0.38
4,4'-DDT	Chronic LOAEL for reproductive effects in brown pelicans (Anderson <i>et al.</i> , 1975).	0.03	diet	1	1	1	0.03
Dieldrin	Chronic LOAEL for increased mortality in offspring of dosed pheasants (Dahlgren and Linder, 1974 cited in WHO, 1989b).	0.57	oral capsule	1	1	1	0.57
Endosulfan I	--	--	--	--	--	--	--
Endrin Aldehyde	Chronic (critical life stage) LOAEL for reproductive effects in screech owls dosed with endrin (Fleming <i>et al.</i> , 1982 cited in Sample <i>et al.</i> , 1996).	0.42	diet	1	1	1	0.42
Heptachlor	--	--	--	--	--	--	--
Heptachlor Epoxide	Chronic LOAEL for reproductive effects (reduced hatchability and chick viability) in chickens (Wolvin <i>et al.</i> , 1969 cited in WHO, 1984).	0.03	diet	1	1	1	0.03
Methoxychlor	Acute LOAEL for mortality in mallard, sharp-tailed grouse and California quail (Hudson <i>et al.</i> , 1984).	2000	diet	1	8	1	250

Table 4-9
Derivation of Chronic LOAEL Toxicity Reference Values (TRVs) for Avian Receptors of Interest
(Page 2 of 2)

Chemical	Study Description and Source	Test Species		Dose Matrix	Dose		Endpoint EF ^c	LOAEL TRV for Birds ^d (mg/kg-day)
		Dose (mg/kg-day)	EF ^a		Duration UF ^b			
Polychlorinated Biphenyls (PCBs)								
PCB-1254	Chronic LOAEL for reproductive effects in ring-necked pheasants (Dahlgren <i>et al.</i> , 1972).	1.8	oral capsule	1	1	1		1.8
PCB-1260	Chronic (critical life stage) LOAEL for reproductive effects in Japanese quail (Call and Harrell, 1974).	533	diet	1	1	1		533
Metals								
Aluminum	--	--	--	--	--	--		--
Antimony	--	--	--	--	--	--		--
Arsenic	Chronic LOAEL for mortality in mallards (USFWS, 1964 as cited in Sample <i>et al.</i> , 1996).	36.2	diet	1	1	1		36.2
Beryllium	--	--	--	--	--	--		--
Cadmium	Chronic LOAEL for reproductive effects in mallards (White and Finley, 1978).	20	diet	1	1	1		20
Chromium, Trivalent	Chronic LOAEL for reproduction in black ducks (Haseltine <i>et al.</i> , unpub. data, reported in Sample <i>et al.</i> , 1996).	13.6	diet	1	1	1		13.6
Chromium	Chronic LOAEL for reproduction in black ducks (Haseltine <i>et al.</i> , unpub. data, reported in Sample <i>et al.</i> , 1996).	13.6	diet	1	1	1		13.6
Chromium, Hexavalent	--	--	--	--	--	--		--
Cobalt	--	--	--	--	--	--		--
Copper	Chronic LOAEL for developmental (growth) effects in 14-day old chickens (Mehring <i>et al.</i> , 1960).	437	diet	1	1	1		437
Cyanide	--	--	--	--	--	--		--
Metals (continued)								
Lead	Acute LOAEL for survival and reproductive effects in American kestrels (Hoffman <i>et al.</i> , 1985).	125	diet	1	8	1		15.6
Mercury (Inorganic)	Chronic (critical life stage) LOAEL for reproductive and developmental effects in Japanese quail (Hill and Schaffner, 1976).	4.27	diet	1	1	1		4.27
Mercury (Organic)	Chronic (critical life stage) LOAEL for mortality effects in Japanese quail (Hill and Soares 1984).	4.27	diet	1	1	1		4.27
Nickel	Chronic LOAEL for mortality and growth effects in mallard ducklings (Cain and Pafford, 1981).	303	diet	1	1	1		303
Selenium	Chronic NOAEL for reproductive effects in mallards (Heinz <i>et al.</i> , 1987 cited in Sample <i>et al.</i> , 1996).	0.8	diet	1	1	1		0.8
Silver	--	--	--	--	--	--		--
Thallium	LD50 for mortality in ring-necked pheasants (Hudson <i>et al.</i> , 1984).	23.7	oral	1	8	5		0.59
Vanadium	Subchronic LOAEL for mortality effects in chickens (Romoser <i>et al.</i> , 1961).	117	diet	1	3	1		39

a Dose-Matrix EF (extrapolation factor): see Section 4.4.2.2.

b Duration UF (uncertainty factor): see Section 4.4.2.3.

c Endpoint UF (uncertainty factor): see Section 4.4.2.4.

d TRV = (test-species dose × dose matrix EF) ÷ (Duration UF × Endpoint UF).

-- Appropriate data are not available from published literature to derive Toxicity Reference Values.

LOAEL = Lowest Observable Adverse Effects Level

Note: A larger TRV list is presented within this table than was used in the ecological risk assessment.

Table 4-10
Derivation of Chronic NOAEL Toxicity Reference Values (TRVs) for Mammalian Receptors of Interest
(Page 1 of 3)

Chemical	Study Description and Source	Test Species	Dose (mg/kg/day)	Matrix	Dose EF ^a	Matrix Duration Endpoint EF ^a	NOAEL TRVs for Mammals* (mg/kg-day)										
							Red Fox	Mink	Raccoon	Short-tailed Shrew	Red Fox	Wolverine					
Bis(2-ethylhexyl)phthalate	Chronic (critical life stage) NOAEL for reproductive effects following exposure to BEHP in mice (Lamb <i>et al.</i> , 1987). Acute LD50 for rats (Dante <i>et al.</i> , 1947 as cited in Sax & Lewis, 1989).	20	diet	1	1	0.42	0.26	0.93	1.11	0.28	8.4	5.2	18.6	22.2	5.8	5.80	
Carbazole		500	oral	1	8	50	0.77	0.47	1.72	2.05	0.52	0.96	0.59	2.15	2.56	0.65	
Dibenzofuran		~	~	~	~	~	~	~	~	~	~	~	~	~	~		
Hexachlorobenzene (mink)	Chronic LOAEL for kit mortality in mink (Bleavins <i>et al.</i> , 1984).	0.15	diet	1	10	1	0.61	2.24	2.36	0.68	0.02	~	~	0.02	0.01	0.01	
Hexachlorobenzene (dog)	Chronic NOAEL for growth and mortality in beagle dogs (Giralia <i>et al.</i> , 1977).	1.25	gelatin capsules	1	1	1.93	1.19	4.33	5.14	1.31	~	1.49	~	~	1.64	2.41	1.49
Hexachlorobutadiene (rat)	Chronic NOAEL for developmental and reproductive effects in rats (Arnold <i>et al.</i> , 1985).	0.69	diet	1	1	0.77	0.47	1.72	2.05	0.52	~	1.19	1.41	~	0.53	0.32	1.19
Acenaphthene	Subchronic NOAEL for mortality and systemic effects in mice (USEPA, 1989 cited in USEPA, 1996d). Subchronic LOAEL for systemic effects in rats (Kroboth <i>et al.</i> , 1989 cited in USEPA, 1987).	175	gavage	1	3	10	0.77	0.47	1.72	2.05	0.52	1.32	0.81	3.51	0.89	3.51	0.89
Acenaphthylene		51.4	oral	1	3	1	0.42	0.26	0.93	1.11	0.28	1.40	0.87	310	370	93.3	93.3
Anthracene		1000	gavage	1	3	1	0.42	0.26	0.93	1.11	0.28	0.42	0.26	0.93	0.42	0.26	0.93
Benz(a)anthracene	Subchronic NOAEL for lifespan and systemic effects in mice (USEPA, 1996d cited in USEPA, 1985). Chronic (critical life stage) LOAEL for reproductive and developmental effects in mice dosed with benz(a)pyrene (Mackenzie and Argovine, 1981).	10	oral	1	10	0.42	0.26	0.93	1.11	0.28	0.42	0.26	0.93	1.11	0.28	1.11	0.28
Benz(a)pyrene	Chronic (critical life stage) LOAEL for reproductive and developmental effects in mice (Mackenzie and Argovine, 1981).	10	oral	1	10	0.42	0.26	0.93	1.11	0.28	0.42	0.26	0.93	1.11	0.28	1.11	0.28
Benz(b)fluoranthene	Chronic (critical life stage) LOAEL for reproductive and developmental effects in mice dosed with benz(a)pyrene (Mackenzie and Argovine, 1981).	10	oral	1	10	0.42	0.26	0.93	1.11	0.28	0.42	0.26	0.93	1.11	0.28	1.11	0.28
Benz(k)fluoranthene	Chronic (critical life stage) LOAEL for reproductive and developmental effects in mice dosed with benz(a)pyrene (Mackenzie and Argovine, 1981).	10	oral	1	10	0.42	0.26	0.93	1.11	0.28	0.42	0.26	0.93	1.11	0.28	1.11	0.28
Chrysene		10	oral	1	10	0.42	0.26	0.93	1.11	0.28	0.42	0.26	0.93	1.11	0.28	1.11	0.28
Dibenz(a,h)anthracene	Chronic (critical life stage) LOAEL for reproductive and developmental effects in mice dosed with benz(a)pyrene (Mackenzie and Argovine, 1981).	10	oral	1	10	0.42	0.26	0.93	1.11	0.28	0.42	0.26	0.93	1.11	0.28	1.11	0.28
Fluoranthene	Subchronic NOAEL for systemic effects in mice (USEPA, 1988c cited in USEPA, 1986).	125	gavage (oil)	1	3	1	0.42	0.26	0.93	1.11	0.28	17.5	10.8	36.8	46.3	11.7	11.7
Fluorene	Subchronic NOAEL for hematological effects in mice (USEPA, 1986 cited in USEPA, 1986).	125	gavage	1	3	1	0.42	0.26	0.93	1.11	0.28	17.5	10.8	36.8	46.3	11.7	11.7
Indeno[1,2,3-c]pyrene	Chronic (critical life stage) LOAEL for reproductive and developmental effects in mice dosed with benz(a)pyrene (Mackenzie and Argovine, 1981).	10	oral	1	10	0.42	0.26	0.93	1.11	0.28	0.42	0.26	0.93	1.11	0.28	1.11	0.28

Table 4-10
Derivation of Chronic NOAEL Toxicity Reference Values (TRVs) for Mammalian Receptors of Interest
 (Page 2 of 3)

Chemical	Study Description # and Source	Test Species	Dose (mg/kg/day)	Dose Matrix	Duration	Endpoint	Body-Weight EF ^a				NOAEL TRVs for Mammals ^b (mg/kg/day)				NOAEL TRVs for Mammals ^b (mg/kg/day)
							EF ^c	Mink	Raccoon	Fox	Mink	Raccoon	Vole	Short-tailed Fox	
2-Methylnaphthalene	Surrogate study (naphthalene); chronic (critical life stage) NOAEL for reproductive and developmental effects in rats (NTP, 1981).	50	gavage (oil)	1	1	0.77	0.47	1.72	2.05	0.52	38.5	23.5	86	103	26.0
Naphthalene	Chronic (critical life stage) NOAEL for reproductive and developmental effects in rats (NTP, 1981).	50	gavage (oil)	1	1	0.77	0.47	1.72	2.05	0.52	38.5	23.5	86	103	26.0
Phenanthrene	Chronic (critical life stage) NOAEL for reproductive and developmental effects in mice dosed with benzol (eprene) (Mackenzie and Argavina, 1981).	10	oral	1	10	0.42	0.26	0.93	1.11	0.28	0.42	0.26	0.93	1.11	0.28
Pyrene	Subchronic NOAEL for systemic (hepatocarcinogenic) effects in mice (USEPA, 1988 cited in USEPA, 1985).	75	oral	1	3	1	0.42	0.26	0.93	1.11	0.28	10.5	6.5	23.3	27.8
Benzene	Chronic LOAEL for mortality in rats (Maltoni et al., 1983 cited in ATSDR, 1997a).	50	gavage	1	1	10	0.77	0.47	1.72	2.05	0.52	3.85	2.35	8.60	10.3
Chlorobenzene	Chronic NOAEL for mortality and hepatic (systemic) effects in rats (NTP, 1985).	42.9	gavage (oil)	1	1	1	0.77	0.47	1.72	2.05	0.52	33	20.2	73.8	87.9
Ethylbenzene	Subchronic NOAEL for liver and kidney toxicity in rats (Wolf et al., 1956).	97.1	oral	1	3	1	0.77	0.47	1.72	2.05	0.52	24.9	15.2	55.7	66.4
Vinyl Chloride	Chronic LOAEL for longevity and mortality effects in rats (Til et al., 1983, 1991 cited in ATSDR, 1997).	1.7	intubation diet	1	1	10	0.77	0.47	1.72	2.05	0.52	0.13	0.08	0.29	0.35
4,4'-DDT	Chronic critical life stage NOAEL for developmental effects in rats (Geller and Heinrich, 1975 cited in ATSDR, 1994a).	28	gavage	1	1	1	0.77	0.47	1.72	2.05	0.52	21.6	13.2	48.2	57.4
Dieldrin	Chronic NOAEL for reproductive effects in rats (FitzHugh, 1948).	0.86	diet	1	1	0.77	0.47	1.72	2.05	0.52	0.66	0.4	1.48	0.66	0.40
Endosulfan I	Chronic NOAEL for reproductive and blood chemistry effects in rats dosed with endosulfan (Dikshita et al., 1984 cited in Sample et al., 1996).	0.21	diet	1	1	10	0.77	0.47	1.72	2.05	0.52	0.02	0.01	0.04	0.01
Endothal	Chronic (critical life stage) NOAEL for reproductive effects in mice dosed with endothal (Good and Ware, 1959 cited in Sample et al., 1996).	1.5	diet	1	3	1	0.77	0.47	1.72	2.05	0.52	0.39	0.24	0.86	1.03
Heptachlor	Chronic NOAEL for reproductive and mortality effects in mice dosed with heptachlor (Crum et al., 1983 cited in Sample et al., 1996).	1	diet	1	1	10	0.42	0.26	0.93	1.11	0.28	0.04	0.03	0.11	0.03
Heptachlor Epoxide	Chronic NOAEL for reproductive effects in beagle dogs (Valasco Chemical, 1973 cited in USEPA, 1984).	0.125	diet	1	1	1	1.93	1.19	4.33	5.14	1.31	0.24	0.15	0.54	0.16
Methoxychlor	Chronic NOAEL for reproductive effects in rats over three generations (Haskell Laboratories, 1966 cited in ATSDR, 1994b).	10	diet	1	1	1	0.77	0.47	1.72	2.05	0.52	7.7	4.7	20.5	5.20
PCB-1254	Summary	~	~	~	~	~	~	~	~	~	0.15	0.09	0.12	0.14	0.10
PCB-1254 (mink)	Chronic critical life stage NOAEL for reproductive effects in mink (Aulerich and Ringer, 1977).	0.15	diet	1	1	1	1	0.51	2.24	2.06	0.68	0.15	0.09	0.34	0.40
PCB-1260	Chronic NOAEL for reproductive and developmental effects in rats (Linder et al., 1974).	6.9	diet	1	1	1	0.77	0.47	1.72	2.05	0.52	5.31	3.24	11.9	14.1

Table 4-10
Derivation of Chronic NOAEL Toxicity Reference Values (TRVs) for Mammalian Receptors of Interest:
 (Page 3 of 3)

Chemical	Study Description and Source	Test Species	Dose (mg/kg-day)	Dose Matrix	Duration	Endpoint	NOAEL TRVs for Mammals' (mg/kg-day)						NOAEL TRVs for Mammals' (mg/kg-day)
							Body-Weight EF ^a	Mink	Raccoon	Meadow Vole	Short-tailed Shrew	Red Fox	
Aluminum	Chronic LOAEL for reproductive effects in mice (Ondracek <i>et al.</i> , 1966). Chronic NOAEL (critical life stage) for developmental and reproductive effects in female rats (Rossi <i>et al.</i> , 1987). Multi-generation LOAEL for reproductive effects in mice (Shroeder and Mitchner, 1971). Chronic NOAEL for systemic and survival effects in rats (Morganridge <i>et al.</i> , 1975).	19.3	water	1	1	10	0.42	0.26	0.93	1.11	0.28	0.81	0.50
Antimony	Chronic NOAEL (critical life stage) for developmental and reproductive effects in female rats (Rossi <i>et al.</i> , 1987).	0.14	water	1	1	1	0.77	0.47	1.72	2.05	0.52	0.11	0.07
Arsenic	Multi-generation LOAEL for reproductive effects in mice (Shroeder and Mitchner, 1971). Chronic NOAEL for effects in the reproductive organs of rats (Sutou <i>et al.</i> , 1980).	1.36	diet & water	1	1	10	0.42	0.26	0.93	1.11	0.28	0.06	0.04
Beryllium	Chronic NOAEL for effects in the reproductive organs of rats (Sutou <i>et al.</i> , 1980).	42.9	diet	1	1	1	0.77	0.47	1.72	2.05	0.52	0.33	0.07
Cadmium	Chronic NOAEL for reproductive effects in rats dosed with trivalent chromium (Vankerkom and Preussmann, 1975). Chronic NOAEL for reproductive effects in rats dosed with trivalent chromium (Vankerkom and Preussmann, 1975). Chronic critical life stage LOAEL for reproductive and developmental effects in rats (Kanoja <i>et al.</i> , 1986).	1	diet	1	1	1	0.77	0.47	1.72	2.05	0.52	0.77	0.47
Chromium, Trivalent	Chronic critical life stage LOAEL for reproductive and developmental effects in rats (Kanoja <i>et al.</i> , 1986).	2932	diet	1	1	1	0.77	0.47	1.72	2.05	0.52	2256	1378
Chromium	Chronic critical life stage LOAEL for reproductive and developmental effects in rats (Kanoja <i>et al.</i> , 1986).	2932	diet	1	1	1	0.77	0.47	1.72	2.05	0.52	2256	1378
Hexavalent Chromium	Chronic critical life stage LOAEL for reproductive and developmental effects in rats (Kanoja <i>et al.</i> , 1986).	31	water	1	1	10	0.42	0.26	0.93	1.11	0.28	1.3	0.81
Chromium, Hexavalent	Chronic (critical life stage) LOAEL for reproductive and developmental effects in rats (Kanoja <i>et al.</i> , 1986). Subchronic NOAEL for reproductive effects in male rats (Nation <i>et al.</i> , 1983).	31	water	1	1	10	0.42	0.26	0.93	1.11	0.28	1.3	0.81
Cobalt	Chronic NOAEL for reproductive and developmental effects in rats (Auerbach <i>et al.</i> , 1982).	5	diet	1	3	1	0.77	0.47	1.72	2.05	0.52	1.28	0.87
Copper	Chronic NOAEL for reproductive and developmental effects (kill survivorship) in mink (Auerbach <i>et al.</i> , 1982). Chronic (critical life stage) LOAEL for reproductive effects in rats (Fawcett and Manner 1981).	12.6	diet	1	1	1	0.61	0.24	2.66	0.68	12.6	7.69	33.5
Cyanide	Subchronic NOAEL for reproductive effects in mice (Johnsonson and Wade, 1986).	68.7	diet	1	1	10	0.77	0.47	1.72	2.05	0.52	5.29	3.23
Lead	Chronic (critical life stage) NOAEL for growth and reproductive effects in mink (Auerbach <i>et al.</i> , 1974).	199	water	3	3	10	0.42	0.26	0.83	1.11	0.28	0.36	0.17
Mercury (Inorganic)	Subchronic NOAEL for mortality and clinical signs of toxicity in mink (Wobesser <i>et al.</i> , 1978a, 1978b).	1.55	diet	1	1	1	0.61	0.24	2.66	0.68	1.55	0.95	4.12
Mercury (Organic)	Chronic (critical life stage) NOAEL for growth and reproductive effects in mink (Auerbach <i>et al.</i> , 1974).	0.17	diet	1	3	1	1	0.61	2.24	2.66	0.68	0.03	0.13
Nickel	Chronic NOAEL for reproductive and developmental effects in rats (Ambrose <i>et al.</i> , 1978).	42.9	diet	1	1	1	0.77	0.47	1.72	2.05	0.52	33	20.2
Selenium	Chronic NOAEL for reproductive effects in rats (Resantini and Beath, 1954).	0.21	water	1	1	1	0.77	0.47	1.72	2.05	0.52	0.16	0.10
Silver	Subchronic NOAEL for mortality in rats (Walker, 1971).	181.2	water	1	3	10	0.77	0.47	1.72	2.05	0.52	46.5	28.4
Titanium	Subchronic LOAEL for reproductive effects in male rats (Formigli <i>et al.</i> , 1986).	0.74	water	1	3	10	0.77	0.47	1.72	2.05	0.52	0.02	0.01
Vanadium	Chronic LOAEL for reproductive effects in rats (Dominig <i>et al.</i> , 1988).	2.1	oral	1	1	10	0.77	0.47	1.72	2.05	0.52	0.16	0.10
<i>Metals (continued)</i>							1.3	0.81	2.88	3.44	0.87	1.30	0.81
												2.88	3.44

^a Dose-Matrix EF (extrapolation factor); see Section 4.4.2.2.

^b Duration UF (uncertainty factor); see Section 4.4.2.3.

^c Endpoint UF (uncertainty factor); see Section 4.4.2.4.

^d Body-weight Extrapolation Factor; see Section 4.4.2.5.

• TRV = (test-species Dose × Dose matrix EF × Duration UF × Endpoint UF) × Body-Weight EF

NOAEL = No Observable Adverse Effects level

Note: A larger TRV is presented within this table than was used in the ecological risk assessment.

Table 4-11
Derivation of Chronic LOAEL Toxicity Reference Values (TRVs) for Mammalian Receptors of Interest
 (Page 1 of 6)

Chemical	Study Description and Source	Test Species	Dose (mg/kg-day)	Dose Matrix	Duration	Endpoint	Body-Weight EF ^d				LOAEL TRVs for Mammals ^c (mg/kg-day)							
							EF ^a	EF ^b	EF ^c	Mink	Raccoon	Vole	Meadow Shrew	Short-tailed Shrew	Red Fox			
Bis(2-ethylhexyl)phthalate	Chronic (critical life stage) LOAEL for reproductive effects following exposure to BEHP in mice (Lamb <i>et al.</i> , 1987). Acute LD50 for rats (Dikke <i>et al.</i> , 1947, as cited in: Sax & Lewis, 1989).	Carbazole	200	diet	1	1	0.42	0.26	0.93	1.11	0.28	84	52	186	222	56.0		
Dibenzofuran	—	1,2-Dichloroethane (total)	—	—	—	—	—	—	—	—	—	—	—	—	—	—		
2,4-Dichloropheno ^f	Chronic (critical life stage) LOAEL for slightly decreased fetal body weights and increased maternal mortality in rats (Rodwell <i>et al.</i> , 1989 cited in ATSDR, 1992.). Subchronic LOAEL for systemic effects in mice (USEPA, 1989n cited in USEPA, 1996a).	2,4-Dimethylphenol	750	gavage oil	1	1	0.77	0.47	1.72	2.05	0.52	9.63	5.88	21.5	25.6	6.50		
Diethyl Phthalate	Subchronic LOAEL for reproductive, developmental and systemic effects in mice (NTP, 1986 cited in ATSDR, 1994.)	Di-n-Octyl Phthalate	7460	—	—	—	—	—	—	—	—	—	—	—	—	—		
Hexachlorobenzene (mink)	Chronic LOAEL for kit mortality in mink (Bleavins <i>et al.</i> , 1984). Chronic LOAEL for growth and mortality in beagle dogs (Gralla <i>et al.</i> , 1977).	Hexachlorobenzene (dog)	0.15	diet	1	1	1	1	0.61	2.24	2.66	0.68	0.15	0.09	0.34	0.4	0.10	
Hexachlorobenzene (rat)	Chronic LOAEL for developmental and reproductive effects in rats (Arnold <i>et al.</i> , 1985). Chronic (critical life stage) LOAEL for reproductive effects in rats (BRRC, 1988 cited in ATSDR, 1992a). Chronic (critical life stage) LOAEL for reproductive and developmental effects in rats (Jones-Price <i>et al.</i> , 1983).	4-Methylphenol	3.43	diet	1	1	1	1	0.77	0.47	1.72	2.05	0.52	2.64	1.61	5.9	7.03	1.78
Phenol	—	Acanthene	450	gavage (oil)	1	1	1	1	0.77	0.47	1.72	2.05	0.52	34.7	212	774	923	234
Acenaphthene	Subchronic LOAEL for mortality and systemic effects in mice (USEPA, 1989 cited in USEPA, 1995d). Subchronic LOAEL for systemic effects in rats (Krobiach <i>et al.</i> , 1969 cited in USEPA, 1987).	Acenaphthylene	350	gavage	1	3	0.42	0.26	0.93	1.11	0.28	49	30.3	109	130	32.7		
Anthracene	—	Benz[a]anthracene	51.4	oral	1	3	1	0.77	0.47	1.72	2.05	0.52	13.2	8.05	29.5	35.1	8.91	
—	Chronic (critical life stage) LOAEL for reproductive and developmental effects in mice dosed with benzof[b]pyrene (Mackenzie and Antweiler, 1981).	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		

Table 4-11
Derivation of Chronic LOAEL Toxicity Reference Values (TRVs) for Mammalian Receptors of Interest
 (Page 2 of 6)

Chemical	Study Description and Source	Test Species		Dose		Matrix Duration		Endpoint		Body-Weight EF ^a		LOAEL TRVs for Mammals* (mg/kg-day)					
		Dose (mg/kg-day)	Matrix	Dose	Matrix	EF ^b	EF ^c	Mink	Raccoon	Meadow Vole	Short-tailed Shrew	Red Fox	Mink	Raccoon	Meadow Vole	Short-tailed Shrew	Red Fox
Benz(a)pyrene	Chronic (critical life stage) LOAEL for reproductive and developmental effects in mice dosed with benz(a)pyrene (Mackenzie and Angelvine, 1981).	10	oral intubation	1	1	0.42	0.26	0.93	1.11	0.28	4.2	2.6	9.3	11.1	11.1	2.80	
Benz(b)fluoranthene	Chronic (critical life stage) LOAEL for reproductive and developmental effects in mice dosed with benz(a)pyrene (Mackenzie and Angelvine, 1981).	10	oral intubation	1	1	0.42	0.26	0.93	1.11	0.28	4.2	2.6	9.3	11.1	11.1	2.80	
Benz(g,h)perylene	Chronic (critical life stage) LOAEL for reproductive and developmental effects in mice dosed with benz(a)pyrene (Mackenzie and Angelvine, 1981).	10	oral intubation	1	1	0.42	0.26	0.93	1.11	0.28	4.2	2.6	9.3	11.1	11.1	2.80	
Benz(k)fluoranthene	Chronic (critical life stage) LOAEL for reproductive and developmental effects in mice dosed with benz(a)pyrene (Mackenzie and Angelvine, 1981).	10	oral intubation	1	1	0.42	0.26	0.93	1.11	0.28	4.2	2.6	9.3	11.1	11.1	2.80	
Chrysene	Chronic (critical life stage) LOAEL for reproductive and developmental effects in mice dosed with benz(a)pyrene (Mackenzie and Angelvine, 1981).	10	oral intubation	1	1	0.42	0.26	0.93	1.11	0.28	4.2	2.6	9.3	11.1	11.1	2.80	
Dibenz(a,h)anthracene	Chronic (critical life stage) LOAEL for reproductive and developmental effects in mice dosed with benz(a)pyrene (Mackenzie and Angelvine, 1981).	10	oral intubation	1	1	0.42	0.26	0.93	1.11	0.28	4.2	2.6	9.3	11.1	11.1	2.80	
Fluoranthene	Subchronic LOAEL for systemic effects in mice (USEPA, 1988c cited in USEPA, 1995f).	250	gavage (oil)	1	3	1	0.42	0.26	0.93	1.11	0.28	35	21.7	77.5	92.5	92.5	23.3
Fluorene	Subchronic LOAEL for hematological effects in mice (USEPA, 1989c cited in USEPA, 1995f).	250	gavage	1	3	1	0.42	0.26	0.93	1.11	0.28	35	21.7	77.5	92.5	92.5	23.3
Indeno(1,2,3-cd)pyrene	Chronic (critical life stage) LOAEL for reproductive and developmental effects in mice dosed with benz(a)pyrene (Mackenzie and Angelvine, 1981).	10	oral intubation	1	1	0.42	0.26	0.93	1.11	0.28	4.2	2.6	9.3	11.1	11.1	2.80	
2-Methylnaphthalene	Surrogate study (naphthalene), chronic (critical life stage) LOAEL for reproductive and developmental effects in rats (NTP, 1991).	150	gavage (oil)	1	1	0.77	0.47	1.72	2.05	0.52	116	70.5	258	308	308	78.0	
Naphthalene	Chronic (critical life stage) LOAEL for reproductive and developmental effects in rats (NTP, 1991).	150	gavage (oil)	1	1	0.77	0.47	1.72	2.05	0.52	116	70.5	258	308	308	78.0	
Phenanthrene	Chronic (critical life stage) LOAEL for reproductive and developmental effects in mice dosed with benz(a)pyrene (Mackenzie and Angelvine, 1981).	10	oral intubation	1	1	0.42	0.26	0.93	1.11	0.28	4.2	2.6	9.3	11.1	11.1	2.80	
Pyrene	Subchronic LOAEL for systemic (hepatotoxic) effects in rats (White and White, 1939).	129	diet	1	3	1	0.77	0.47	1.72	2.05	0.52	33.1	20.2	74	88.2	22.4	

Table 4-11
Derivation of Chronic LOAEL Toxicity Reference Values (TRVs) for Mammalian Receptors of Interest
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Chemical	Study Description and Source	Test Species		Dose (mg/kg-day)	Dose Matrix	Matrix Duration	Endpoint	Body-Weight EF ^d				LOAEL TRVs for Mammals* (mg/kg-day)				
		ER ^c	EF ^c					Mink	Raccoon	Vole	Shrew	Red Fox	Mink	Raccoon	Vole	Shrew
Acetone	Subchronic LOAEL for reproductive effects in rats (Dietz <i>et al.</i> , 1991). Chronic LOAEL for mortality in rats (Maltoni <i>et al.</i> , 1983 as cited in ATSDR, 1997a).	3400	water	1	3	1	0.77	0.47	1.72	2.05	0.52	873	533	1949	2323	589
Benzene	Chronic (critical life stage) LOAEL for fetal resorption in rabbits (Jones-Price <i>et al.</i> , 1984 cited in ATSDR, 1992.). Chronic (critical life stage) LOAEL for developmental effects in rats (Wilson, 1954 cited in ATSDR, 1994.). Chronic LOAEL for mortality and hepatic (systemic) effects in rats (NTP, 1985).	50	gavage	1	1	1	0.77	0.47	1.72	2.05	0.52	38.5	23.5	86	103	26.0
Carbon Disulfide	Chronic (critical life stage) LOAEL for developmental effects in rats (Wilson, 1954 cited in ATSDR, 1994.).	25	gavage (oil)	1	1	1	1.4	0.86	3.12	3.71	0.95	35	21.5	78	92.8	23.8
Carbon Tetrachloride	Chronic LOAEL for mortality and hepatic (systemic) effects in rats (NTP, 1985).	1400	gavage	1	1	1	0.77	0.47	1.72	2.05	0.52	1078	658	2408	2870	728
Chlorobenzene	Chronic LOAEL for mortality and systemic effects in rats (NCI, 1977a cited in ATSDR, 1990).	85.7	gavage (oil)	1	1	1	0.77	0.47	1.72	2.05	0.52	66	40.3	147	176	44.6
1,1-Dichloroethane	Chronic LOAEL for mortality and systemic effects in rats (NCI, 1977a cited in ATSDR, 1990).	382	gavage	1	1	1	0.77	0.47	1.72	2.05	0.52	294	180	657	783	199
1,2-Dichloroethane	Chronic LOAEL for mortality in rats (NCI, 1978).	75	gavage (oil)	1	1	1	0.77	0.47	1.72	2.05	0.52	57.8	35.3	129	154	39.0
Ethylbenzene	Subchronic LOAEL for liver and kidney toxicity in rats (Wolf <i>et al.</i> , 1956). Chronic LOAEL for systemic and survival effects in rats (NCA, 1982).	281	oral intubation	1	3	1	0.77	0.47	1.72	2.05	0.52	74.7	45.6	167	199	50.4
Methylene Chloride	Subchronic LOAEL for reproductive effects in rats (Srivastava <i>et al.</i> , 1989 cited in ATSDR, 1992.). Chronic LOAEL for mortality and systemic effects in mice (NCL, 1977c).	50	water	1	1	1	0.77	0.47	1.72	2.05	0.52	38.5	23.5	86	103	26.0
Styrene	Chronic LOAEL for reproductive effects in rats (Srivastava <i>et al.</i> , 1989 cited in ATSDR, 1992.). Chronic LOAEL for mortality and systemic effects in mice (NCL, 1977c).	400	gavage (oil)	1	3	1	0.77	0.47	1.72	2.05	0.52	103	62.7	229	273	69.3
Tetrachloroethene	Chronic (critical life stage) LOAEL for reproductive effects in mice (Nawrot and Staples, 1979).	386	gavage (oil)	1	1	1	0.42	0.26	0.93	1.11	0.28	162	100	359	428	108
Toluene	Chronic LOAEL for mortality and systemic effects in rats (NCI, 1977b).	260	gavage (oil)	1	1	1	0.42	0.26	0.93	1.11	0.28	109	67.6	242	289	72.8
1,1,1-Trichloroethane	Chronic (multiple generation) LOAEL for maternal toxicity and developmental effects in rats (NTP, 1986).	750	gavage (oil)	1	1	1	0.77	0.47	1.72	2.05	0.52	578	353	1290	1538	390
Trichloroethene	Chronic LOAEL for longevity and mortality effects in rats (Til <i>et al.</i> , 1983, 1991 cited in ATSDR, 1997).	214	diet	1	1	1	0.77	0.47	1.72	2.05	0.52	165	101	368	439	111
Vinyl Chloride	Chronic LOAEL for longevity and mortality effects in rats (Til <i>et al.</i> , 1983, 1991 cited in ATSDR, 1997).	1.7	diet	1	1	1	0.77	0.47	1.72	2.05	0.52	1.31	0.8	2.92	3.49	0.88
Xylene (total)	Chronic (critical life stage) LOAEL for reproductive effects in mice dosed with mixed isomers of xylene (Marks <i>et al.</i> , 1992).	2.58	gavage	1	1	1	0.42	0.26	0.93	1.11	0.28	1.08	0.67	2.4	2.86	0.72

Table 4-11
Derivation of Chronic LOAEL Toxicity Reference Values (TRVs) for Mammalian Receptors of Interest
(Page 4 of 6)

Chemical	Study Description and Source	Test Species		Dose (mg/kg-day)	Dose Matrix	Matrix Duration	Endpoint EF ^a	EF ^b	Body-Weight EF ^c				LOAEL TRVs for Mammals* (mg/kg-day)			
		Meadow Vole	Pesticides Shrew						Meadow Vole	Short-tailed Shrew	Red Fox	Mink	Raccoon	Vole	Shrew	
Aldrin	Chronic LOAEL for reproductive effects in rats (Treon and Cleveland, 1955 cited in Sample <i>et al.</i> , 1996).	1.07	diet	1	1	1	0.77	0.47	1.72	2.05	0.52	0.82	0.5	1.84	2.19	0.56
alpha-chlordane	Chronic (six generation) LOAEL for reproductive effects in mice dosed with chlordane (Kepplinger <i>et al.</i> , 1968 cited in USEPA, 1995b).	10	diet	1	1	1	0.42	0.26	0.93	1.11	0.28	4.2	2.6	9.3	11.1	2.80
gamma-chlordane	Chronic (six generation) LOAEL for reproductive effects in mice dosed with chlordane (Kepplinger <i>et al.</i> , 1968 cited in USEPA, 1995b).	10	diet	1	1	1	0.42	0.26	0.93	1.11	0.28	4.2	2.6	9.3	11.1	2.80
4,4'-DDD 4,4'-DDE	Chronic LOAEL for systemic effects in rats (Rassi <i>et al.</i> , 1983 cited in ATSDR, 1994a).	41.5	diet	1	1	1	0.77	0.47	1.72	2.05	0.52	32	19.5	71.4	85.1	21.6
4,4'-DDT	Chronic LOAEL for reproductive effects in rats (FitzHugh, 1948).	4.29	diet	1	1	1	0.77	0.47	1.72	2.05	0.52	3.3	2.02	7.38	8.79	2.23
Dieldrin	Chronic (3 generation) LOAEL for reproductive effects in rats (Treon and Cleveland, 1955 cited in Sample <i>et al.</i> , 1996).	0.21	diet	1	1	1	0.77	0.47	1.72	2.05	0.52	0.16	0.1	0.36	0.43	0.11
Endosulfan I	Subchronic LOAEL for increased pup mortality effects in rats dosed with endosulfan (Hoechst, 1982 cited in ATSDR, 1993a).	8	diet	1	3	1	0.77	0.47	1.72	2.05	0.52	2.05	1.25	4.59	5.47	1.39
Endosulfan II	Subchronic LOAEL for increased pup mortality effects in rats dosed with endosulfan (Hoechst, 1982 cited in ATSDR, 1993a).	8	diet	1	3	1	0.77	0.47	1.72	2.05	0.52	2.05	1.25	4.59	5.47	1.39
Endosulfan Sulfate	Subchronic LOAEL for increased pup mortality effects in rats dosed with endosulfan (Hoechst, 1982 cited in ATSDR, 1993a).	8	diet	1	3	1	0.77	0.47	1.72	2.05	0.52	2.05	1.25	4.59	5.47	1.39
Endrin	Chronic (critical life stage) LOAEL for reproductive effects in mice (Good and Ware, 1969 as cited in Sample <i>et al.</i> , 1996).	1	diet	1	1	1	0.42	0.26	0.93	1.11	0.28	0.42	0.26	0.93	1.11	0.28
Endrin Aldehyde	Chronic (critical life stage) LOAEL for reproductive effects in mice dosed with endrin (Good and Ware, 1969 as cited in Sample <i>et al.</i> , 1996).	1	diet	1	1	1	0.42	0.26	0.93	1.11	0.28	0.42	0.26	0.93	1.11	0.28
Endrin Ketone	Chronic (critical life stage) LOAEL for reproductive effects in mice dosed with endrin (Good and Ware, 1969 as cited in Sample <i>et al.</i> , 1996).	1	diet	1	1	1	0.42	0.26	0.93	1.11	0.28	0.42	0.26	0.93	1.11	0.28

Table 4-11
Derivation of Chronic LOAEL Toxicity Reference Values (TRVs) for Mammalian Receptors of Interest
 (Page 5 of 6)

Chemical	Study Description and Source	Test Species		Dose (mg/kg-day)	Matrix	Duration	Endpoint	Body-Weight EF ^a				LOAEL TRVs for Mammals* (mg/kg-day)					
		1	1					EF ^b	EF ^c	Mink	Raccoon	Vole	Shrew	Red Fox			
Heptachlor	Chronic (critical life stage) LOAEL for reproductive and mortality effects in mink (Crum <i>et al.</i> , 1993 cited in Sample <i>et al.</i> , 1996). Chronic LOAEL for reproductive effects in beagle dogs (Velsicol Chemical, 1973 cited in USEPA, 1994e). Chronic LOAEL for reproductive effects in rats over three generations (Haskell Laboratories, 1966 cited in ATSDR, 1994b).		0.175	diet	1	1	1	1	0.61	2.24	2.66	0.68	1	0.61	2.24	2.66	
Heptachlor Epoxide			50	diet	1	1	1	0.77	0.47	1.72	2.05	0.52	38.5	23.5	86	103	
Methoxychlor																	
PCB-1254	Summary	"	"	diet	0.75	1	1	1	1	1	2.24	2.66	0.68	0.75	0.46	1.16	1.37
PCB-1254 (mink)	Chronic (critical life stage) LOAEL for reproductive effects in mink (Aulerich and Ringer, 1977). Chronic LOAEL for reproductive effects in oldfield mice (McCoy <i>et al.</i> , 1995). Chronic LOAEL for reproductive effects in white-footed mice (Linney, 1987). Chronic LOAEL for reproductive and developmental effects in rats (Linder <i>et al.</i> , 1974).		1.5	diet	1	1	1	0.34	0.21	0.77	0.91	0.23	--	--	1.16	1.37	
PCB-1254 (old-field mouse)			1.27	diet	1	1	1	0.38	0.23	0.84	1	0.25	0.48	0.29	1.07	1.27	
PCB-1254 (w-foot mouse)			35.4	diet	1	1	1	0.77	0.47	1.72	2.05	0.52	27.3	16.6	60.9	72.6	
PCB-1260																	
Aluminum (solid)	Chronic (critical life stage) LOAEL for increased pup mortality in rats (Bemuzzi <i>et al.</i> , 1986 cited in ATSDR, 1992.).	155	gavage (water)	1	1	1	0.77	0.47	1.72	2.05	0.52	119	72.9	267	318	80.6	
Aluminum	Chronic LOAEL for reproductive effects in mice (Ondrejcka <i>et al.</i> , 1986). Chronic LOAEL (critical life stage) for developmental and reproductive effects in female rats (Rossi <i>et al.</i> , 1987). Multi-generation LOAEL for reproductive effects in mice (Shroeder and Mitchner, 1971).	19.3	water	1	1	1	0.42	0.26	0.93	1.11	0.28	8.11	5.02	17.9	21.4	5.40	
Antimony		1.44	water	1	1	1	0.77	0.47	1.72	2.05	0.52	1.11	0.68	2.48	2.95	0.75	
Arsenic		1.35	diet & water	1	1	1	0.42	0.26	0.93	1.11	0.28	0.57	0.35	1.26	1.5	0.38	
Beryllium		"	diet	1	1	1	0.77	0.47	1.72	2.05	0.52	7.7	4.7	17.2	20.5	5.20	
Cadmium	Chronic LOAEL for effects in the reproductive organs of rats (Sutou <i>et al.</i> , 1980).	10	--	--	--	--	--	--	--	--	--	--	--	--	--		
Chromium, Trivalent		--	--	--	--	--	--	--	--	--	--	--	--	--	--		
Chromium																	

Table 4-11
Derivation of Chronic LOAEL Toxicity Reference Values (TRVs) for Mammalian Receptors of Interest
 (Page 6 of 6)

Chemical	Study Description and Source	Test Species	Dose (mg/kg-day)	Dose Matrix	Duration	Endpoint	Body-Weight EF ^d				LOAEL TRVs for Mammals* (mg/kg-day)			
							EF ^a	EF ^b	Mink	Recoon	Vole	Shrew	Red Fox	
Chromium, Hexavalent	Chronic (critical life stage) LOAEL for reproductive and developmental effects in rats (Kanodia <i>et al.</i> , 1986).	31	water	1	1	0.42	0.26	0.93	1.11	0.28	13	8.06	28.8	34.4
Hexavalent Chromium	Chronic (critical life stage) LOAEL for reproductive and developmental effects in rats (Kanodia <i>et al.</i> , 1986).	31	water	1	1	0.42	0.26	0.93	1.11	0.28	13	8.06	28.8	34.4
Cobalt	Subchronic LOAEL for reproductive effects in male rats (Nation <i>et al.</i> , 1983).	20	diet	1	3	1	0.77	0.47	1.72	2.05	0.52	5.13	3.13	11.5
Copper	Chronic LOAEL for reproductive and developmental effects in rats (Nation <i>et al.</i> , 1983).	16.3	diet	1	1	1	0.61	2.24	2.66	0.68	24.2	14.8	54.2	64.4
Cyanide	Chronic (critical life stage) LOAEL for reproductive effects in rats (Tawé and Maner 1981).	68.7	diet	1	1	1	0.77	0.47	1.72	2.05	0.52	52.9	32.3	118
Hexavalent Chromium (solid)	Chronic (critical life stage) LOAEL for reproductive effects in mice (Trivedi <i>et al.</i> , 1989).	66.7	water	1	1	0.42	0.26	0.93	1.11	0.28	28	17.3	62	74
Lead	Subchronic LOAEL for reproductive effects in mice (Johansson and Wide, 1986).	199	water	3	3	1	0.42	0.26	0.93	1.11	0.28	83.6	51.7	185
Mercury (Inorganic)	Chronic LOAEL for the onset of potentially significant kidney damage in mice (Revis <i>et al.</i> , 1989).	13.2	diet	1	1	1	0.42	0.26	0.93	1.11	0.28	5.54	3.43	12.3
Mercury (Organic)	Subchronic LOAEL for mortality and clinical signs of toxicity in mink (Wobeser <i>et al.</i> , 1978a, 1978b).	0.27	diet	1	3	1	0.77	0.47	1.72	2.05	0.52	66	40.3	147
Mercury (Organic) rat	Chronic LOAEL for reproductive effects in rats (Verschueren <i>et al.</i> , 1976).	0.21	diet	1	1	1	0.77	0.47	1.72	2.05	0.52	0.16	0.1	0.36
Nickel	Chronic LOAEL for reproductive and developmental effects in rats (Ambrose <i>et al.</i> , 1976).	85.7	diet	1	1	1	0.77	0.47	1.72	2.05	0.52	66	40.3	147
Selenium	Chronic LOAEL for reproductive effects in rats (Rosserfield and Beath, 1954).	0.36	water	1	1	1	0.77	0.47	1.72	2.05	0.52	0.28	0.117	0.62
Silver	Subchronic LOAEL for mortality in rats (Walker, 1971).	362.4	water	1	3	1	0.77	0.47	1.72	2.05	0.52	93	56.8	208
Thallium	Subchronic LOAEL for reproductive effects in male rats (Formigli <i>et al.</i> , 1986).	0.74	water	1	3	1	0.77	0.47	1.72	2.05	0.52	0.19	0.12	0.42
Vanadium	Chronic LOAEL for reproductive effects in rats (Damringo <i>et al.</i> , 1986).	2.1	oral intubation			1	0.77	0.47	1.72	2.05	0.52	1.62	0.99	3.61
Zinc	Chronic (critical life stage) LOAEL for reproductive effects in rats (Schliecker and Cox, 1968).	471	diet	1	1	1	0.77	0.47	1.72	2.05	0.52	363	221	810

^a Dose-Matrix EF (Extrapolation Factor); see Section 4.4.2.c.

^b Duration UF (Uncertainty Factor); see Section 4.4.2.b.

^c Endpoint UF (Uncertainty Factor); see Section 4.4.2.c.

^d Body-weight Extrapolation Factor; see Section 4.4.2.d.

* TRV = (test species dose x dose matrix EF) ÷ (Duration UF x Endpoint UF) x Body-Weight EF.

LOAEL = Lowest Observable Adverse Effects Level

Note: A larger TRV list is presented within this table than was used in the ecological risk assessment.

**DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT**

TABLE 5-1

**COMPARISON OF PAH CHEMICALS OF INTEREST (COIs) WITH CONSENSUS
BASED SQGs FOR GRAND RIVER SEDIMENT SAMPLES**

GOI ^a	95% UCL of Mean ^b	TEC ^c	PEC ^d
Benzo(a)anthracene	0.239	0.108	1.05
Chrysene	0.241	0.166	1.29
Fluoranthene	0.298	0.423	2.23
2-Methylnaphthalene	0.233	NA ^d	NA
Naphthalene	0.964	0.176	0.561
Phenanthrene	0.271	0.204	1.17
Pyrene	0.277	0.195	1.52

- a. TEC - Threshold Effect Concentration
- b. PEC - Probable Effects Concentration

c. From Table 3-1.

Source of TEC and PEC values is MacDonald et al. (2000).

d. NA - Not Available

**DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT**

TABLE 5-2

OTHER ORGANIC CHEMICAL COMPARISONS FOR GRAND RIVER SEDIMENT SAMPLES

Parameter	95% LICE TOC Mean ^a	Screening Benchmark ^b	TEC ^c	PEC ^d
Benzene	0.116	0.20	---	---
Chlorobenzene	0.020	0.30	---	---
Ethylbenzene	0.125	0.754	---	---
Heptachloroperoxide	0.0021	---	0.0025	0.016
Vinyl Chloride ^e	0.015	---	---	---

- a. From Table 3-1
- b. Chronic SQB mg/kg @ 1% TOC from Table 4-2
- c. TEC - Threshold Effect Concentration
- d. PEC - Probable Effects Concentration
- e. Human Health WQS is 5.25 mg/L

**DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT**

TABLE 5-3

**INORGANIC COMPARISONS TO BENCHMARKS
FOR GRAND RIVER SEDIMENT SAMPLES**

COI	Mean ^a	ERL ^b	LEL ^c	95% UCL of Mean ^d	TEC ^e	PEC ^e
Antimony	4	2.00	NA	4	NA	NA
Arsenic	11.800	33.00	6	15.7	9.79	33
Barium	59.3	NA	NA	88.6	NA	NA
Beryllium	0.612	NA	NA	0.797	NA	NA
Total Chromium	25.8	81	26	51.3	43.4	111
Hex Chromium	1.9	NA	NA	5	NA	NA
Cyanide	1.6	NA	NA	2.7	NA	NA
Lead	12.3	35	31	15.1	35.8	128.0
Mercury	0.42	0.15	0.2	0.5	0.18	1.06
Nickel	14.3	30	16	18.1	22.7	48.6
Selenium	1.1	NA	NA	1.1	NA	NA
Vanadium	13.1	NA	NA	18.5	NA	NA

- a. From Table 3-1
- b. ERL - Effects Range - Low
- c. LEL - Lowest Effects Level
- d. TEC - Threshold Effects Concentration
- e. PEC - Probable Effects Concentration

DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT

TABLE 5-3b

**COMPARISONS TO OHIO WATER QUALITY STANDARDS
FOR GRAND RIVER SURFACE WATER COIs (mg/L)**

Parameter	Mean ^a	Max ^b	OMZA ^c	OMZM ^d	Mean Exceeds OMZA?	Max Exceeds OMZM?
Total Chromium	0.012	0.22	0.14	2.98d	No	No
Hexavalent Chromium (filtered)	0.013	0.228	0.011	0.016	Yes	Yes
Hexavalent Chromium (unfiltered)	0.009	0.039	0.011	0.016	No	Yes
Total Dissolved Solids	796.1	2940	1500	NA	No	Yes

- a. From Table 3-3
- b. Lake Erie Drainage Basin Surface Water Aquatic Life Chronic Criteria, Outside the Mixing Zone Average
- c. Lake Erie Drainage Basin Surface Water Aquatic Life Acute Criteria, Outside the Mixing Zone Maximum
- d. Hardness-dependent criterion, based on a maximum hardness value of 178 (mg/L CaCO₃)

NA = Not available

**DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT**

TABLE 5-4

**COMPARISON OF PAH CHEMICALS OF INTEREST (COIs) WITH CONSENSUS
BASED SQGs FOR LAKE ERIE SEDIMENT SAMPLES**

COI	Maximum Detected Concentration ^a	SQG ^b	PEC ^c
Acenaphthene	0.18	NA ^d	NA
Acenaphthylene	0.43	NA	NA
Anthracene	1.1	0.0572	0.845
Benzo(a)anthracene	2.1	0.108	1.05
Benzo(a)pyrene	1.6	0.15	1.45
Benzo(b)fluoranthene	2.1	NA	NA
Benzo(g,h,i)perylene	0.78	NA	NA
Benzo(k)fluoranthene	0.68	NA	NA
Chrysene	2	0.166	1.29
Dibenz(a,h)anthracene	0.37	33	NA
Fluoranthene	4.6	0.423	2.23
Fluorene	0.92	0.0774	0.536
Indeno(1,2,3-cd)pyrene	0.89	NA	NA
2-Methylnaphthalene	0.28	NA	NA
Naphthalene	5.15	0.176	0.561
Phenanthrene	3	0.204	1.17
Pyrene	2.9	0.195	1.52
Total PAHs	24.3	1.61	22.8

- a. From Table 3-2
- b. TEC - Threshold Effect Concentration
- c. PEC - Probable Effects Concentration
- d. NA - Not Available

**DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT**

TABLE 5-5

OTHER ORGANIC CHEMICAL COMPARISONS FOR LAKE ERIE SEDIMENT SAMPLES

Parameter	95% UCL of Mean ^a	Screening Benchmark ^b	SQG ^c	
			TEC ^d	PEC ^e
Carbazole	0.22	0.27	---	---
4,4-DDE	0.0022	---	0.0032	0.0313
4,4-DDT	0.0061	---	0.0042	0.0629
Dieldrin	0.0024	0.052	0.0019	0.0618
Endosulfan	0.0002	0.0029	---	---
Methoxychlor	0.028	0.019	---	---

- a. From Table 3-2
- b. Chronic SQB mg/kg @ 1% TOC from Table 4-2
- c. Consensus-based Sediment Quality Guidelines (MacDonald, *et al.*, 2000) from Table 4-2
- d. TEC - Threshold Effect Concentration
- e. PEC - Probable Effects Concentration

**DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT**

TABLE 5-6

**INORGANIC COMPARISONS TO BENCHMARKS
FOR LAKE ERIE SEDIMENT SAMPLES**

Chemical (COI)	Mean ^a	ERL ^b	LEL ^c	95% UCL of Mean ^d	TEC ^e	PEC ^f
Antimony	1.98	2.00	NA	2.3	NA	NA
Total Chromium	20.3	81	26	39.6	43.4	111
Cyanide	0.739	NA	NA	1.57	NA	NA

- a. From Table 3-2
- b. ERL - Effects Range - Low
- c. LEL - Lowest Effects Level
- d. TEC - Threshold Effects Concentration
- e. PEC - Probable Effects Concentration

**DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT**

TABLE 5-7

**HAZARD QUOTIENTS FOR AQUATIC WILDLIFE RECEPTORS OF INTEREST
GRAND RIVER STUDY AREA**

COIs	Total Hazard Quotients (HQ) ^a									
	Piscivorous bird Belted Kingfisher		Invertivorous bird Spotted sandpiper		Piscivorous mammal Mink		Invertivorous mammal Raccoon		NOAEL	LOAEL
	NOAEL	LOAEL	NOAEL	LOAEL	Mink	NOAEL	LOAEL	NOAEL		
<i>Semivolatile Organic Compounds (SVOCs)</i>										
Bis(2-ethylhexyl)phthalate	0.01	NC	0.009	NC	0.002	0.0002	0.002	0.002	0.0002	0.0002
<i>Polycyclic Aromatic Hydrocarbons (PAHs)</i>										
Benzo(a)anthracene	3.9E-05	NC	3.6E-05	NC	0.03	0.003	0.03	0.03	0.003	0.003
Chrysene	4.0E-05	NC	3.6E-05	NC	0.03	0.003	0.03	0.03	0.003	0.003
Fluoranthene	4.8E-05	NC	4.8E-05	NC	0.001	0.0004	0.001	0.001	0.0004	0.0004
2-Methylnaphthalene	--	--	8.0E-06	NC	--	--	--	4E-05	1E-05	1E-05
Naphthalene	--	--	3.3E-05	NC	--	--	--	0.0002	6E-05	6E-05
Phenanthrene	0.03	0.003	0.04	0.004	0.03	0.003	0.03	0.04	0.004	0.004
Pyrene	4.4E-05	NC	4.7E-05	NC	0.001	0.0004	0.001	0.001	0.0005	0.0005
Total PAHs ^b	0.03	0.003	0.04	0.004	0.10	0.01	0.09	0.09	0.01	0.01
<i>Volatile Organic Compounds (VOCs)</i>										
Benzene	--	--	NC	NC	--	--	--	0.0002	2.2E-05	2.2E-05
Chlorobenzene	--	--	NC	NC	--	--	--	4.2E-06	2.1E-06	2.1E-06
Ethylbenzene	--	--	NC	NC	--	--	--	3.4E-05	1.1E-05	1.1E-05
Vinyl Chloride	--	--	NC	NC	--	--	--	0.001	0.0001	0.0001
Heptachlor Epoxide	0.070	0.01	0.08	0.01	0.000425	0.0003	0.0005	0.0003	0.0003	0.0003

DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT

TABLE 5-7

HAZARD QUOTIENTS FOR AQUATIC WILDLIFE RECEPTORS OF INTEREST
GRAND RIVER STUDY AREA

COIs	Total Hazard Quotients (HQ) ^a									
	Piscivorous bird		Invertivorous bird		Piscivorous mammal		Invertivorous mammal			
	Belted Kingfisher	Spotted sandpiper	Mink	Raccoon	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
<i>Metals</i>										
Antimony	NC 0.12	NC 0.05	NC 0.18	NC 0.07	1.16 8.35	0.11 0.88	1.72 11.8	0.18 1.35		
Arsenic	Barium --	Beryllium NC	Spotted sandpiper NC	Invertivorous bird NC	Piscivorous mammal NOAEL 0.0008	Invertivorous mammal LOAEL 0.0007	Invertivorous mammal NOAEL NC	Invertivorous mammal LOAEL 0.001		
Chromium	2.05 0.03	0.41 NC	3.16 0.05	0.63 0.02	0.0007 0.002	0.0007 0.002	0.0007 0.002	0.001 0.03	0.003 0.003	0.003 0.003
Cyanide	Hexavalent Chromium 0.03	0.03 NC	0.04 0.04	0.12 0.12	0.02 0.01	0.01 0.01	0.19 0.19	0.02 0.02		
Lead	0.40 0.03	0.11 0.01	0.61 0.010	0.16 0.005	0.06 0.28	0.06 0.28	0.01 0.18	0.09 0.13	0.02 0.08	
Mercury (Organic)	Mercury (Inorganic) --	0.01 --	0.04 0.03	0.02 0.02	0.28 --	0.28 --	0.18 0.18	0.14 0.13	0.01 0.01	0.004 0.004
Mercury (Total) ^c	0.03 0.01	0.01 0.007	0.04 0.01	0.02 0.01	0.02 0.02	0.02 0.02	0.18 0.01	0.14 0.03	0.08 0.03	0.08 0.01
Nickel	Selenium 0.30	0.15 0.30	0.45 0.23	0.23 0.22	0.13 0.13	0.08 0.08	0.13 0.13	0.33 0.33	0.19 0.33	0.19 0.33
Vanadium	0.09 0.05	0.05 0.05	3.69 3.69	0.08 0.08			0.4 0.4	5.59 5.59		0.56 0.56

a HQ = ADD / TRV;

b Sum of all PAHs.

c Sum of organic and inorganic mercury HQs.
 TRVs are presented in Section 4.4.

NC = Not Calculated: TRV not available.

-- Not a COI in this medium.

DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT

TABLE 5-8

HAZARD QUOTIENTS FOR AQUATIC WILDLIFE RECEPTORS OF INTEREST
LAKE ERIE SHORELINE STUDY AREA

COIs	Total Hazard Quotients (HQ) ^a						Invertivorous mammal Raccoon	
	Piscivorous bird Belted Kingfisher		Invertivorous bird Spotted sandpiper		Piscivorous mammal Mink			
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL		
<i>Semivolatile Organic Compounds (SVOCs)</i>								
Bis(2-ethylhexyl)phthalate	0.02	NC	0.02	NC	0.004	0.0004	0.004	
Carbazole	--	--	NC	NC	--	--	0.0003	
<i>Polycyclic Aromatic Hydrocarbons (PAHs)</i>								
Acenaphthene	--	--	0.008	0.0008	--	--	8E-05	
Acenaphthylene	--	--	2E-05	NC	--	--	4E-05	
Anthracene	0.68	0.07	0.49	0.05	0.002	0.004	0.0004	
Benzo(a)anthracene	0.002	NC	0.001	NC	1.28	0.13	NC	
Benzo(a)pyrene	0.001	NC	0.0009	NC	0.98	0.10	0.11	
Benzo(b)fluoranthene	0.002	NC	0.001	NC	1.28	0.13	0.09	
Benzo(g,h,i)perylene	0.0006	NC	0.0004	NC	0.48	0.05	0.11	
Benzo(k)fluoranthene	0.0005	NC	0.0004	NC	0.41	0.04	0.04	
Chrysene	0.002	NC	0.001	NC	1.22	0.12	1.09	
Dibenz(a,h)anthracene	0.0003	NC	0.0002	NC	0.23	0.02	0.11	
Fluoranthene	0.004	NC	0.003	NC	0.07	0.03	0.02	
Florene	0.62	0.06	0.45	0.04	0.01	0.01	0.03	
Indeno(1,2,3-cd)pyrene	0.0007	NC	0.0005	NC	0.54	0.05	0.06	
2-Methylnaphthalene	--	--	2E-05	NC	--	--	0.006	
Naphthalene	--	--	0.0003	NC	--	--	0.005	
Phenanthrene	1.82	0.18	1.31	0.13	1.83	0.18	1.64	
Pyrene	0.002	NC	0.002	NC	0.07	0.02	0.02	
Total PAHs^b	2.45	0.24	1.76	0.18	2.53	0.30	2.25	

DIAMOND SHAMROCK PAINESVILLE WORKS SITE
LAKE ERIE AND GRAND RIVER BASELINE ECOLOGICAL RISK ASSESSMENT

TABLE 5-8

HAZARD QUOTIENTS FOR AQUATIC WILDLIFE RECEPTORS OF INTEREST
LAKE ERIE SHORELINE STUDY AREA

COIs	Total Hazard Quotients (HQ) ^a							
	Piscivorous bird		Invertivorous bird		Piscivorous mammal		Invertivorous mammal	
	Belted kingfisher	Spotted sandpiper	Mink	Raccoon	NOAEL	LOAEL	NOAEL	LOAEL
<i>Pesticides</i>								
4,4'-DDE	0.13	0.01	0.13	0.01	0.00007	5E-05	9E-05	6E-05
4,4'-DDT	6.67	0.67	3.45	0.35	0.009	0.002	0.006	0.001
Dieldrin	0.07	0.009	0.07	0.009	0.08	0.009	0.12	0.01
Endosulfan 1	--	--	2E-07	NC	--	--	6E-06	1E-06
Methoxychlor	0.004	0.0004	0.003	0.0003	0.004	0.0008	0.004	0.0007
<i>Metals</i>								
Antimony	NC	NC	NC	NC	0.79	0.08	1.26	0.13
Chromium	1.82	0.36	2.75	0.55	0.0007	NC	0.001	NC
Cyanide	0.02	NC	0.03	NC	0.01	0.001	0.02	0.002

a HQ = ADD / TRV;

b Sum of all PAHs.

TRVs are presented in Section 4.4.

NC = Not Calculated: TRV not available.

-- Not a COI in this medium.